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.

DEPARTMENT VISION

To be a centre of excellence in teaching and learning to produce the competent & socially responsible professionals in the domain of Electrical & Electronics Engineering.

DEPARTMENT MISSION

I. To educate students with core knowledge of Electrical and Electronics Engineering to excel in their professional career.

II. To develop problem solving skills, professional skills and ethical values among the students for the betterment of mankind.

III. To prepare technically competent and socially responsible Electrical Engineer to serve the future needs of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the program will be able to

PEO1: Achieve successful professional career in Electrical Engineering and allied disciplines.

PEO2: Pursue higher studies and continuously engage in upgrading the professional skills.

PEO3: Demonstrate professional & ethical values, effective communication skills and teamwork to solve issues related to profession, society and environment.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

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 sustainable 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 management 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.

PROGRAM SPECIFIC OUTCOMES (PSOs) :

PSO1: Apply knowledge & competencies to analyze & design Electrical & Electronics Circuits, Controls and Power Systems, Machines & Industrial Drives.

PSO2: Use Software/Hardware tools for the design, simulation and analysis of Electrical and Electronics Systems.

Contents of VI-SEM

1.0 Student Help Desk

Sl. No	Coordination Work	Contact Person	
		Faculty	Instructor
01	Attestations	Dr. B. V. Madiggond	-
02	Exam forms signature, Overall department administration, Counseling/interaction with Parents/Students.		
03	Research Centre Coordinator, Academic Coordinator		
04	Project Coordinator, KSCST Coordinator, Hobby & Mini Project Coordinator	Prof. S. D. Hirekodi	-
05	Mentorship Coordinator, GATE Coaching Coordinator	Prof. H. R. Zinage	-
06	Dept. Association Coordinator	Prof. M. P. Yenagimath	-
07	Website Coordinator, Professional Body (ISTE & IEEE) Coordinator, Alumni Coordinator	Prof. O. B. Heddurshetti	-
08	AICTE/VTU/NIRF Coordinator, Dept. News & Publicity Coordinator, AICTE Activity Coordinator	Prof. A. U. Neshti	-
10	Library Coordinator	Prof. A. U. Neshti	Shri. S. B. Beelur
11	IA & EMS Coordinator	Prof. K. B. Negalur	-
12	Seminar Coordinator, News letter/Technical Magazine Coordinator	Prof. S. G. Huddar	-
13	Dispensary	Dr. Arun G. Bullannavar, Contact No. 9449141549	
Class Teacher			
15	4th Semester	Prof. A. U. Neshti	Shri. S. B. Beelur
16	6th Semester	Prof. O. B. Heddurshetti	Shri. V. M. Mutalik
17	8th Semester	Prof. H. R. Zinage	Shri. R. S. Bardol

2.0 Departmental Resources

Department of Electrical and Electronics Engineering was established in the year 1996 and is housedin a total area of **1339 Sq. Mtrs.**

2.1 Faculty Position

S.N.	Category	No. in position	Average experience
1	Teaching faculty	10	18 Y
2	Technical supporting staff	3	25 Y
3	Helper	2	19 Y

2.2 Major Laboratories

SL. No.	Name of the laboratory	Area in Sq. Mtrs	Amount Invested (Rs)
01	Electronics Lab	71	4,49,488.00
02	Operational Amplifier & Linear Integrated Lab		1,29,776.00
03	Power Electronics Lab	92	7,85,162.00
04	Control Systems Lab		2,14,127.00
05	Power System Simulation Lab	71	17,95,111.00
06	Computer Aided Electrical Drawing Lab		6,50,988.40
07	Microcontroller Lab / Digital Signal Processing Lab	72	5,94,122.00
09	Electrical Machines Lab	200	14,85,725.0
10	Relay & High Voltage Lab	94	11,72,383.00
11	Basic Electrical Engg. Lab	96	42,321.00
	Total	**696**	73,19,203.40

3.0 Faculty Details

S.N.	Faculty Name	Designation	Qualification	Area of specialization	Professional membership	Industry Experience (in years)	Teaching Experience (in years)	Contact Nos.
01	Dr. B. V. Madiggond	HOD/Prof.	Ph. D	Power Electronics	LMISTE, YHAI	-	29	9343454993
02	Prof. V. B. Dhere	Asst. Prof.	M. Tech, (Ph. D)	Electronics & Telecommunication	LMISTE, IMPARC	4	25	9886597573
03	Prof. S. D. Hirekodi	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	22	9480849338
04	Prof. H. R. Zinage	Asst. Prof.	M. Tech.	Power System	LMISTE	-	22	9480849335
05	Prof. M. P. Yenagimath	Asst. Prof.	M. Tech (Ph. D)	VLSI & ES	LMISTE	1	16.5	9341449466
06	Prof. O. B. Heddurshetti	Asst. Prof.	M. Tech.	Power Electrics	LMISTE	1	15	9448420509
07	Prof. A. U. Neshti	Asst. Prof.	M. Tech.	Digital Electronics	ISTE	-	14	9538223362
08	Prof. K. B. Neglur	Asst. Prof.	M. Tech.	Industrial Electronics	LMISTE	-	09	9886644507
09	Prof. S. G. Huddar	Asst. Prof.	M. Tech.	Power System Engg.	LMISTE	-	09	9742066852
10	Prof. P. I. Savadatti	Asst. Prof.	M. Tech.	Digital Electronics	-	-	07	9964315436

4.0 Institute Academic Calendar

S J P N Trust's
Hirasugar Institute of Technology, Nidasoshi.
Inculcating Values, Promoting Prosperity
Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi
Recognized under 2(f) & 12B of UGC Act, 1956
Accredited at 'A' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE

IQAC | File I-11 | 2022-23 (Even) | Rev: 01

CALENDAR OF EVENTS OF VI SEM FOR THE ACADEMIC YEAR 2022-23 (Even)

Date	Events
20-03-2023	Commencement of VI Sem
07-04-2023	World Health Day
14-04-2023	Fire Prevention Day
20-04-2023 To 22-04-2023	First Internal Assessment for VI Semester & Feedback –I on Teaching-Learning
22-04-2023	World Earth Day
25-04-2023	Display& Submission of 1st Internal Assessment Marks to Office
26-04-2023	World Intellectual Property Day
01-05-23 To 07-05-23	Nutrition Week
22-05-2023	TECHNOVISION - 23
23-05-2023	HSIT QUEST- 23
24-05-2023	HSIT SAMBRAMA- 23
25-05-2023	Graduation Day for VIII Sem
01-06-2023 To 03-06-2023	Second Internal Assessment for VI Semester & Feedback –II on Teaching-Learning
05-06-2023	World Environmental Day
06-06-2023	Display& Submission of 2nd Internal Assessment Marks to Office
21-06-2023	International Yoga Day
03-07-2023 To 05-07-2023	Third Internal Assessment for VI Semester
01-07-2023 To 07-07-2023	Banamahostava Week
07-07-2023 To 08-07-2023	Lab Internal Assessment
10-07-2023	Display of Final Internal Assessment Marks
10-07-2023	Last working day for VI Semester
11-07-2023 To 21-07-2023	Theory Practical Exams
24-07-2023 To 12-08-2023	Theory Exams
09-09-2023	Internship (Four Week)
11-09-2023	Commencement of VII Sem

March -2023

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	

22- Yugadi

April -2023

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						

04- Mahaveer Jayanti , 07- Good Friday , 14- Ambedkar Jayanti

May -2023

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			

01- May Day (Karmika Dinacharane)

June -2023

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	

29-Bakrid

July -2023

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						

29-Moharam

Note: Mahaveer Jayanti is on 4.04.2023 instead of 3.04.2023 as per Revised VTU list of Holidays

IQAC Coordinator
Dr. R.R.Maggavi

Principal
Dr. S. C. Kamate

5.0 Department Academic Calendar

S J P N Trust's
Hirasugar Institute of Technology, Nidasoshi.
Inculcating Values, Promoting Prosperity
Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi
Recognized under 2(f) & 12B of UGC Act, 1956
Accredited at 'A' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE

EEE | COE | 2022-23 (Even) | Rev: 00

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGG.

CALENDAR OF EVENTS FOR THE VI & VIII SEMESTER 2022-23 (Even)

Date	Events
13-02-2023	Commencement of VIII Sem
28-02-2023	World Science Day
16-03-2023	First Internal Assessment for VIII Semester & Feedback –I on Teaching -Learning
20-03-2023	Display & Submission of 1st Internal Assessment Marks to Office
20-03-2023	Commencement of VI Sem
07-04-2023	World Health Day
13-04-2023	Second Internal Assessment for VIII Semester & Feedback –II on Teaching -Learning
14-04-2023	Fire Prevention Day
17-04-2023	Display & Submission of 2nd Internal Assessment Marks to Office
20-04-2023 to 22-04-2023	First Internal Assessment for VI Semester & Feedback –I on Teaching -Learning
21-04-2023	Group Discussion
22-04-2023	World Earth Day
25-04-2023	Display & Submission of 1st Internal Assessment Marks to Office
26-04-2023	World Intellectual Property Day
01-05-2023 to 07-05-2023	Nutrition Week
05-05-2023	Guest lecture by resource person from Industry/Alumni
05-05-2023	Project Exhibition
11-05-2023	Third Internal Assessment for VIII Semester
13-05-2023	Last Working day for VIII Semester Display of final Internal Assessment Marks
19-05-2023	Box Cricket
22-05-2023	TECHNOVISION - 23
23-05-2023	HSIT QUEST- 23
24-05-2023	HSIT SAMBRAMA- 23
25-05-2023	Graduation Day for VIII Sem
01-06-2023 to 03-06-2023	Second Internal Assessment for VI Semester &Feedback –II on Teaching-Learning
05-06-2023	World Environmental Day
06-06-2023	Display& Submission of 2nd Internal Assessment Marks to Office
09-06-2023	Farewell function to final year students
16-06-2023	Industrial Visits
21-06-2023	International Yoga Day
23-06-2023	Quiz Competition
30-06-2023	Story telling Competition
01-07-2023	Hobby Project competition for 2nd and 3rd year students.
03-07-2023 to 05-07-2023	Third Internal Assessment for VI Semester
01-07-2023 to 07-07-2023	Banamahostava Week
07-07-2023 to 08-07-2023	Lab Internal Assessment
10-07-2023	Display of Final Internal Assessment Marks
10-07-2023	Last working day for VI Semester

February-2023

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				

18-Mahashivaratri

March-2023

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	

22-Yugadi

April-2023

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						

03-Mahaveer Jayantti, 07-Good Friday,
14-Ambedkar Jayanti

May-2023

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			

01-Karmika Dinacharane (Labor Day)

June-2023

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	

29-Bakrid

July-2023

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						

29-Moharam

Shri. M. P. Yenagimath
EESSA Coordinator

Dr. B. V. Madiggond
HOD

Dr. S. C. Kamate
Principal

6.0 Scheme of Teaching & Examination

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

VI SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18 EE61	Control Systems	EEE	3	2	--	03	40	60	100	4
2	PCC	18 EE62	Power System Analysis – 1	EEE	3	2	--	03	40	60	100	4
3	PCC	18 EE63	Digital Signal Processing	EEE	3	2	--	03	40	60	100	4
4	PEC	18 EE64X	Professional Elective -1	EEE	3	--	--	03	40	60	100	3
5	OEC	18 EE65X	Open Elective -A	EEE	3	--	--	03	40	60	100	3
6	PCC	18 EEL66	Control System Laboratory	EEE	--	2	2	03	40	60	100	2
7	PCC	18 EEL67	Digital Signal Processing Laboratory	EEE	--	2	2	03	40	60	100	2
8	MP	18 EEMP68	Mini-project		--	--	2	03	40	60	100	2
9	Internship	--	Internship	To be carried out during the vacation/s of VI and VII semesters and /or VIIand VIII semesters.								
				TOTAL	**15**	**10**	**06**	**24**	**320**	**480**	**800**	**24**

Note: PCC: Professional core, PEC: Professional Elective, OE: Open Elective, MP: Mini-project.

Professional Elective -1

Course code under18XX64X	Course Title
18EE641	Introduction to Nuclear Power
18EE642	Electrical Engineering Materials
18EE643	Computer Aided Electrical Drawing
18EE644	Embedded System
18EE645	Object Oriented Programming using C++
18EE646	Electric Vehicles Technologies
18EE647	Sensors and Transducers

Open Elective -A

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (Please refer to the list of open electives under 18XX65X).
Selection of an open elective shall not be allowed if,
The candidate has studied the same course during the previous semesters of the programme.
The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.A similar course, under any category, is prescribed in the higher semesters of the programme.
Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Mini-project work:
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

Subject Title	**CONTROL SYSTEMS**		
Subject Code	18EE61	**CIE Marks**	40
Number of Lecture Hrs / Week(L:T:P)	3:2:0	**SEE Marks**	60
Total Number of Lecture Hrs	50	**Exam Hours**	03
			CREDITS – 04

FACULTY DETAILS:		
Name: Prof. O. B. Heddurshetti	**Designation:** Asst. Professor	**Experience:**17
No. of times course taught:03	**Specialization:** Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical &Electronics Engineering	I/II	Basic Electrical Engineering
02	Electrical &Electronics Engineering	I/II	Engineering Mathematics
03	Electrical &Electronics Engineering	III	Electrical Circuit Analysis

2.0 Course Objectives

- To define a control system.
- To explain the necessity of feedback and types of feedback control systems.
- To introduce the concept of transfer function and its application to the modeling of linear systems.
- To discuss the stability of linear time invariant systems and Routh - Hurwitz criterion.
- To obtain transfer function of systems through block diagram manipulation and reduction.
- To use Mason's gain formula for finding transfer function of a system.
- To demonstrate mathematical modeling of control systems, components and to develop design criteria for manipulating the time response in terms of time domain response specification.
- To discuss transient and steady state time response of a simple control system.
- To investigate the trajectories of the roots of the characteristic equation when a system parameter is varied.
- To conduct the control system analysis in the frequency domain.
- To determine the controller or compensator configuration and parameter values relative to how it is connected to the controlled process given the design specifications.

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
C310.1	Demonstrate the mathematical modelling of electrical, mechanical and analogous systems.	L3	1,2,3,8,12
C310.2	Apply block diagram and signal flow graph methods to obtain transfer function of systems.	L3	1,2,3,8,12
C310.3	Determine transient and steady state time response of a simple control system& investigate the performance of a given system in time and frequency domains.	L5	1,2,3,8,12
C310.4	Determine the stability of the system by using Routh criterion, root locus, bode plot and Nyquist plot methods.	L5	1,2,3,8,12
C310.5	Design control system using different controllers.	L5	1,2,3,8,12

4.0 Course Content

Module-1
Introduction to control systems: Introduction, classification of control systems.
Mathematical models of physical systems: Modelling of mechanical system elements, electrical systems, Analogous systems, Transfer function, Single input single output systems, Procedure for deriving transfer functions, servomotors, synchros, gear trains.

Module-2
Block diagram: Block diagram of a closed loop system, procedure for drawing block diagram and block diagram reduction to find transfer function.
Signal flow graphs: Construction of signal flow graphs, basic properties of signal flow graph, signal flow graph algebra, construction of signal flow graph for control systems.

Module-3
Time Domain Analysis: Standard test signals, time response of first order systems, time response of second order systems, steady state errors and error constants, types of control systems.
Routh Stability criterion: BIBO stability, Necessary conditions for stability, Routh stability criterion, difficulties in formulation of Routh table, application of Routh stability criterion to linear feedback systems, relative stability analysis.

Module-4
Root locus technique: Introduction, root locus concepts, construction of root loci, rules for the construction of root locus.
Frequency Response analysis: Co-relation between time and frequency response – 2 nd order systems only.
Bode plots: Basic factors G(iw)/H(jw), General procedure for constructing bode plots, computation of gain margin and phase margin.

Module-5

Nyquist plot: Principle of argument, Nyquist stability criterion, assessment of relative stability using Nyquist criterion.

Design of Control Systems: Introduction, Design with the PD Controller, Design with the PI Controller, Design with the PID Controller, Design with Phase-Lead Controller, Design with Phase - Lag Controller, Design with Lead-Lag Controller**.**

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VII & VIII	Project	Design of open loop and closed loop systems

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	Design of control systems for Automobiles, including PEM fuel cells.
02	Industrial control of machines and processes.
03	Development of prototype models.

7.0 Gap Analysis and Mitigation

Sl No	Delivery Type	Details
01	Practical	Practical implementation of theoretical concepts can be done during practical sessions of the course control systems laboratory

8.0 Books Used and Recommended to Students

Text Books

1. Control Systems by Anand Kumar.

Reference Books

1. Automatic Control Systems by FaridGolnaraghi, Benjamin C. Kuo, Wiley , 9th Edition, 2010.
2. Control Systems Engineering by Norman S. Nise, 4th Edition, 2004.
3. Modern Control Systems by Richard C Dorf et al, Pearson, 11th Edition, 2008.
4. Control Systems, Principles and Design by M.Gopal,McGaw Hill, 4th Edition, 2012.
5. Control Systems Engineering by S. Salivahanan et al, Pearson, 1st Edition, 2015.

Additional Study material & e-Books

1. Control Engineering by Ganesh Rao and Chennavenkatesh, Pearson.

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

Website and Internet Contents References

https://nptel.ac.in/courses/107/106/107106081/
https://www.tutorialspoint.com › control_systems
http://www.mee.tcd.ie/~sigmedia/pmwiki/uploads/Teaching.3C1/control_systems.pdf

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Xplore: IEEE Control Systems Magazine	www.ieeexplore.ieee.org
2	Journal of Control Theory and Applications, Journal of Real-Time Image Processing etc	www.Springer.com

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: 50 Marks scaled down to 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 Lecturer	% of Portion
1	1	Introduction	20
	2	Classification of control systems	
	3	Modelling of mechanical system elements	
	4	Electrical systems	
	5	Analogous systems	
	6	Transfer function	
	7	Single input single output systems	
	8	Procedure for deriving transfer functions	
	9	Servomotors, synchros	
	10	Gear trains	
2	11	Block diagram of a closed loop system,	20
	12	procedure for drawing block diagram	
	13	Block diagram reduction problems	
	14	Block diagram reduction to find transfer function	
	15	Construction of signal flow graphs	
	16	Basic properties of signal flow graph	
	17	Signal flow graph algebra	
	18	construction of signal flow graph for control systems	
	19	Problems	
	20	Problems	

3	21	Standard test signals	20
	22	Time response of first order systems	
	23	Time response of second order systems	
	24	Steady state errors	
	25	Error constants	
	26	Types of control systems	
	27	Routh Stability criterion: BIBO stability	
	28	Necessary conditions for stability, Routh stability criterion	
	29	Difficulties in formulation of Routh table	
	30	Application of Routh stability criterion to linear feedback systems, relative stability analysis	
4	31	Introduction	20
	32	Root locus concepts	
	33	Construction of root loci	
	34	Rules for the construction of root locu	
	35	Frequency Response analysis: Co-relation between time and frequency response – 2 nd order systems only	
	36	Bode plots introduction	
	37	Bode plots: Basic factors G(iw)/H(jw	
	38	General procedure for constructing bode plots	
	39	computation of gain margin	
	40	computation of phase margin	
5	41	Nyquist plot: Principle of argument	20
	42	Nyquist stability criterion	
	43	Assessment of relative stability using Nyquist criterion	
	44	Problems on Nyquist criterion	
	45	Design of Control Systems: Introduction	
	46	Design with the PD Controller	
	47	Design with the PI Controller	
	48	Design with the PID Controller, Design with Phase-Lead Controller	
	49	Design with Phase - Lag Controller	
	50	Design with Lead-Lag Controller	

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: Questions on module 1	Students will be able to demonstrate the mathematical modelling of electrical, mechanical and analogous systems.	Module 1 of the syllabus	3	Individual Activity.	Anand Kumar
2	Assignment 2: Questions on module 2	Students will be able to apply block diagram and signal flow graph methods	Module 2 of the syllabus	5	Individual Activity.	Anand Kumar

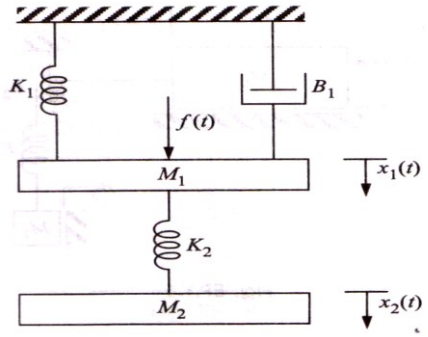
		to obtain transfer function of systems.				
3	Assignment 3: Questions on module 3	Students will be able to investigate the performance of a given system in time and frequency domains.	Module 3 of the syllabus	8	Individual Activity.	Anand Kumar
4	Assignment 4: Questions on module 4	Students will be able to determine the stability of the system by using Routh criterion, root locus, bode plot and Nyquist plot methods	Module 4 of the syllabus	10	Individual Activity.	Anand Kumar
5	Assignment 5: Questions on module 5	Students will be able to design control system using different controllers.	Module 5 of the syllabus	12	Individual Activity.	Anand Kumar

15.0 QUESTION BANK

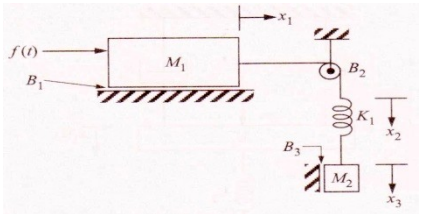
MODULE 1

1) Define and compare open loop control systems with closed loop control system, with examples.

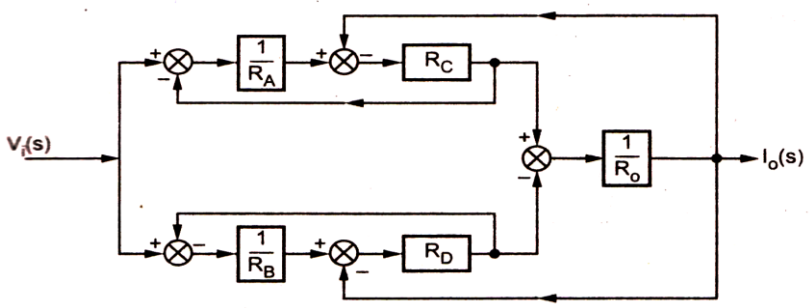
2) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force voltage analogy.



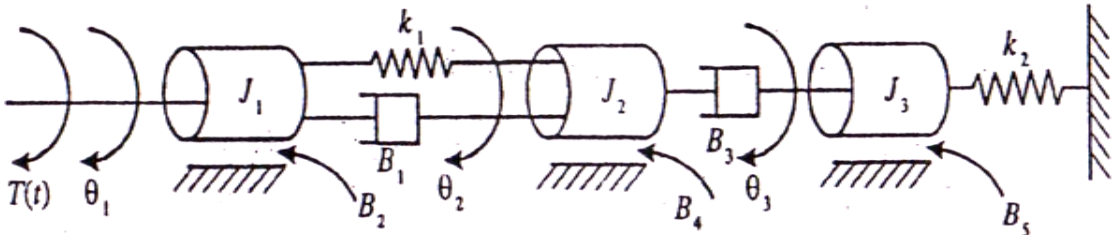
3) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force current.



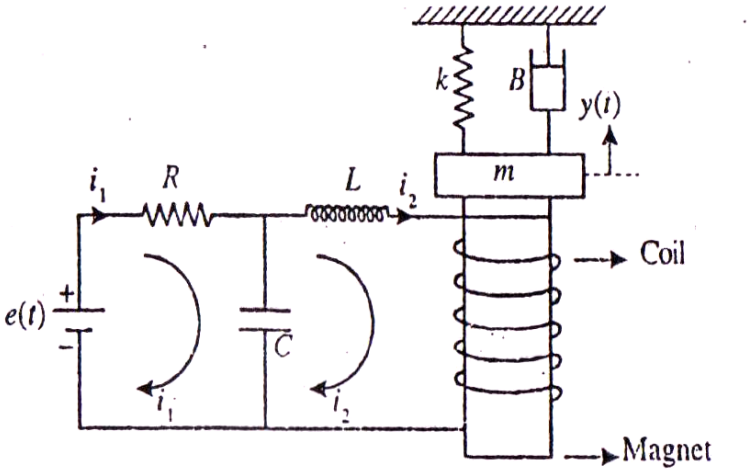
4) For the system shown in Fig. below determine $I_0(s)/V_i(s)$ by block diagram reduction technique.



5) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force voltage .



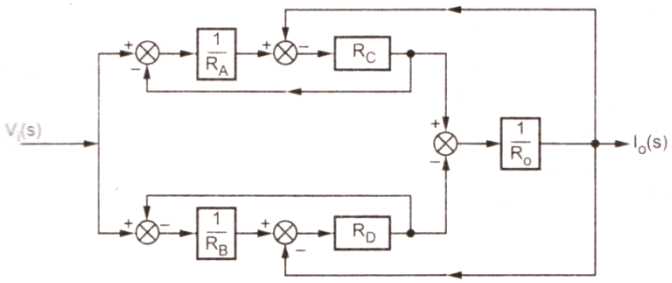
6) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force voltage.



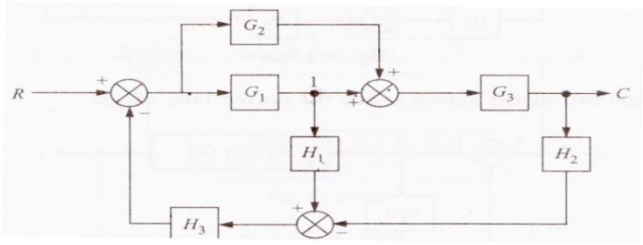
7) Obtain the transfer function of an armature controlled DC servomotor.
8) Mention merits and demerits of open loop and closed loop control systems and give an example for each.

MODULE 2

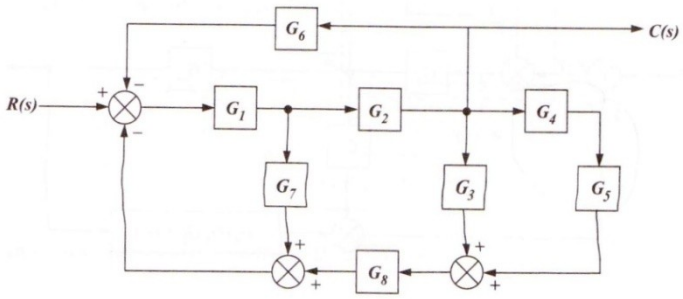
1) Determine the transfer function C(s)/R(s) of the system shown below by block diagram reduction method.



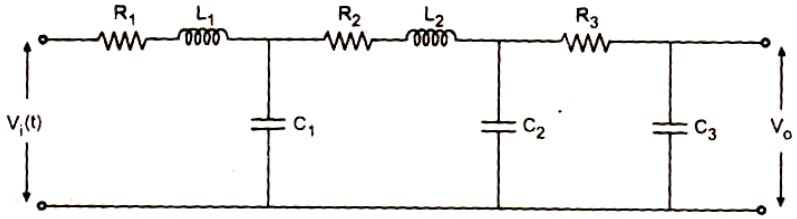
2) Determine the transfer function C(s)/R(s) of the system shown below by block diagram reduction method.



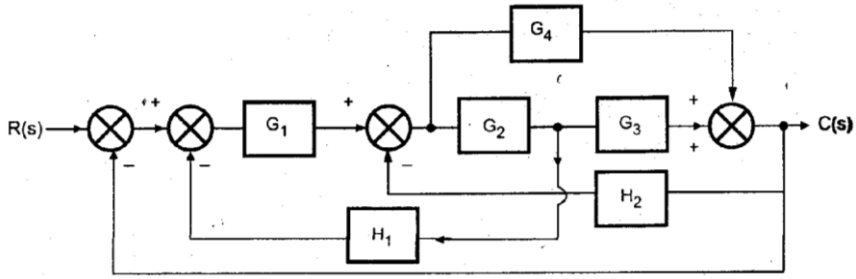
3) Determine the transfer function C(s)/R(s) of the system shown below by block diagram reduction method.



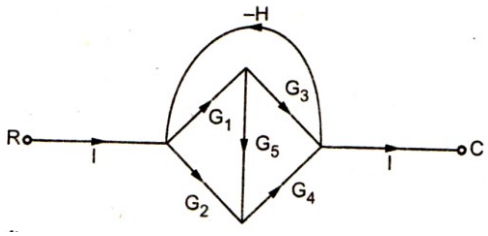
4) Discuss rule of block reduction technique in detail.
5) Draw a block diagram to describe the electrical circuit given in the Fig.



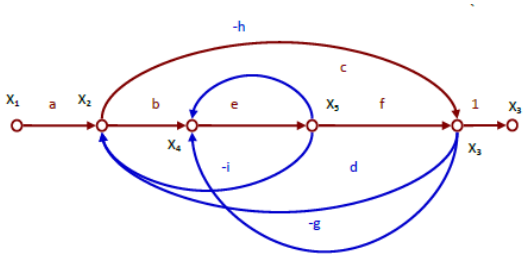
6) Obtain the overall transfer function for the block diagram shown below by the block diagram reduction technique.



7) Obtain MGF.



8) For the system described by the signal flow graph shown in fig, obtain the closed loop transfer function C(s) / R(s) , using Mason's gain formula.



MODULE 3

1) Define the following for an under damped second order system.
   a) Rise Time b) Peak overshoot c) Settling Time.
2) Define the following terms
   a) Transient response b) steady state response.

3) Derive the expression for peak time.

4) The loop transfer function of transfer function is given by
   i) Determine the static error coefficients
   ii) Determine steady state error coefficients for the input $r(t) = 2t_2 + 5t + 10$

$$G(s)H(s) = \frac{100}{s^2(s+4)(s+12)}$$

5) Derive expressions for peak response time t_p and maximum overshoot M_p of an under damped second order control system subjected to step input
6) For a unity feedback control system with $G(s) = 10(S+2) / S_2 (S+1)$. Find
   i) The static error coefficients
   ii) Steady state error when the input transform is $R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^2}$

7) Explain Routh-Hurwitz's criterion for determining the stability of a system and mention any three limitations of R-H criterion.
8) Define: i) Marginally stable systems; ii) absolutely stable system; iii) conditionally stable systems.

MODULE 4

1) Sketch the root locus for a unity feedback control system with open loop transfer function:

$$G(s) = \frac{K}{s(s+6s+25)}$$

2) The open loop transfer function of a feedback control system in

$$G(s)H(s) = \frac{K}{(s+1)(s+2)(s+3)}$$

Check whether the following points are on the root locus. If so, find the value of K at these points, i) S = -1.5 ii) S = -0.5 + j2.

3) Sketch the root locus plot for a negative feedback control system characterized by an open loop transfer function, Comment on stability.

$$G(s)H(s) = \frac{K}{s(s+3)(s^2+3s+11.2s)}.$$

4) Define brake away / in point on a root locus. Explain any one method of determining the same.
5) State the advantages and limitations of frequency domain approach.
6) Determine the transfer function, of a system whose asyptotic gain plot is shown in fig.

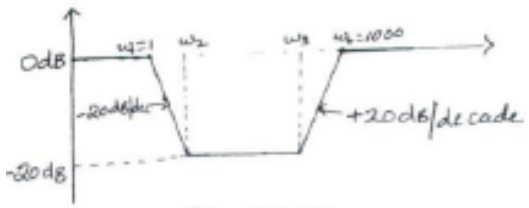


Fig. Q6 (b)

7) List the effects of lead compensation.

MODULE 5

1) Explain Nyquist's stability criterion.
2) What is Proportional controller and what are its advantages?
3) Explain the drawbacks in P-controller?
4) What is integral control action?
5) What are the advantages and disadvantages in integral controller?
6) What is PI controller?
7) What is PD controller?
8) What is PID controller?
9) Derive expressions for the transfer function of lead, lag and lead-lag compensators.
10) Explain the effects and limitations of phase lag control.

Prepared by & Checked by		
24/03/23	24.3.23	
Prof. O. B. Heddurshetti	**HOD**	**Principal**

Subject Title	POWER SYSTEM ANALYSIS-1		
Subject Code	18EE62	**CIE Marks**	40
Number of Lecture Hrs / Week (L:T:P)	3:2:0	**SEE Marks**	60
Total Number of Lecture Hrs	50	**Exam Hours**	03
			Credits-04

FACULTY DETAILS:		
Name: Sujata G Huddar	**Designation:** Asst. Professor	**Experience:** 09
No. of times course taught: 02 (including present)	**Specialization:** Power Systems Engineering	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical and Electronics Engg	III	EPG
02	Electrical and Electronics Engg	V	TD

2.0 Course Objectives

- To introduce the per unit system and explain its advantages and computation.
- To explain the concept of one line diagram and its implementation in problems.
- To explain the necessity and conduction of short circuit analysis.
- To explain analysis of three phase symmetrical faults on synchronous machine and simple power systems.
- To discuss selection of circuit breaker.
- To explain symmetrical components, their advantages and the calculation of symmetrical components of voltages and currents in un-balanced three phase circuits.
- To explain the concept of sequence impedance and its analysis in three phase unbalanced circuits.
- To explain the concept of sequence networks and sequence impedances of an unloaded synchronous generator, transformers and transmission lines.
- To explain the analysis of synchronous machine and simple power systems for different unsymmetrical faults using symmetrical components.
- To discuss the dynamics of synchronous machine and derive the power angle equation for a synchronous machine
- Discuss stability and types of stability for a power system and the equal area criterion for the evaluation of stability of a simple system.

3.0 Course Outcomes

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

	Course Outcome	Cognitive Level	POs
C311.1	Model the power system components & construct per unit impedance diagram of power system.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C311.2	Analyze three phase symmetrical faults on power system.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C311.3	Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C311.4	Analyze various unsymmetrical faults on power system.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C311.5	Examine dynamics of synchronous machine and determine the power system stability.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
Total Hours of instruction		**50**	

4.0 Course Content

Module-1

Representation of Power System Components : Introduction, Single-phase Representation of Balanced Three Phase Networks, One-Line Diagram and Impedance or Reactance Diagram, Per Unit (PU) System, Steady State Model of Synchronous Machine, Power Transformer, Transmission of electrical Power, Representation of Loads . **10 Hours**

Module-2

Symmetrical Fault Analysis: Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine(On No Load), Short Circuit of a Loaded Synchronous Machine, Illustrative simple examples on power systems. Selection of Circuit Breakers. **10 Hours.**

Module-3

Symmetrical Components: Introduction, Symmetrical Component Transformation, Phase Shift in Star-Delta Transformers, Sequence Impedances of Transmission Lines, Sequence Impedances and Sequence Network of Power System, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Transformers, Construction of Sequence Networks of a Power System. **10 Hours.**

Module-4

Unsymmetrical Fault Analysis: Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line-To-Ground (LG) Fault, Line-To-Line (LL) Fault, Double Line- To-Ground (LLG) Fault, Open Conductor Faults. **10Hours.**

Module-5

Power System Stability: Introduction, Dynamics of a Synchronous Machine, Review of Power Angle Equation. Simple Systems, Steady State Stability, Transient Stability, Equal Area Criterion, Factors Affecting Transient Stability, Multi machine stability studies, classical representation. **10 Hours.**

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VII	Computer techniques in power system analysis	All
02	VII	Power system simulation lab	Swing curve, power angle curve, fault analysis
03	VIII	Power system operation & control	All

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Power system modeling
02	Analyze power system stability
03	Fault analysis of power system by software tools.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Practical	Doing fault analysis using mi-power simulation & obtaining power angle curve using MATLAB.

8.0 Books Used and Recommended to Students

Text Books
Reference Books
1 Power System Analysis and Design J.Duncan Glover et al Cengage 4th Edition, 2008
2 Power System Analysis Hadi Sadat McGraw Hill 1st Edition, 2002

Additional Study material & e-Books
1. Power system analysis and stability by V. Neelakantan
2. http://ebookkdownload.blogspot.in/search/label/Electrical%20Engineering

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

Website and Internet Contents References
1) http://www.power-eng.com/index.html
2) http://www.ieee-pes.org/
3) http://www.electricalsolutions.net.au/content/efficiency-renewables/article/emergency-lighting-an-essential-service-783180538
4) http://www.edisontechcenter.org/LauffenFrankfurt.html

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Transactions on power system	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=59
2	IEEE power engineering review	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=39
3	Power and Energy technology systems journal	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6687318

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: 50 Marks scaled down to 30 marks
Assignment marks: 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 four 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
I	1.	**Representation of Power System Components :** Introduction	20
	2.	Single-phase Representation of Balanced Three Phase Networks	
	3.	One-Line Diagram and Impedance or Reactance Diagram	
	4.	Per Unit (PU) System, Steady State Model of Synchronous Machine	
	5.	Power Transformer, Transmission of electrical Power, Representation of Loads.	
	6.	Numerical	
	7.	Numerical	
	8.	Numerical	
	9.	Numerical	
	10.	Numerical	
II	11.	**Symmetrical Fault Analysis:** Introduction	20
	12.	Transient on a Transmission Line	
	13.	Short Circuit of a Synchronous Machine(On No Load)	

	14.	Short Circuit of a Loaded Synchronous Machine	
	15.	Illustrative simple examples on power systems, Selection of Circuit Breakers	
	16.	Numerical	
	17.	Numerical	
	18.	Numerical	
	19.	Numerical	
	20.	Numerical	
III	21.	**Symmetrical Components:** Introduction	**20**
	22.	Symmetrical Component Transformation	
	23.	Phase Shift in Star-Delta Transformers	
	24.	Sequence Impedances of Transmission Lines , Sequence Impedances and Sequence Network of Power System	
	25.	Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines , Sequence Impedances and Networks of Transformers	
	26.	Construction of Sequence Networks of a Power System	
	27.	Numerical	
	28.	Numerical	
	29.	Numerical	
	30.	Numerical	
IV	31.	**Unsymmetrical Fault Analysis:** Introduction, Symmetrical Component Analysis of Unsymmetrical Faults	**20**
	32.	Single Line-To-Ground (LG) Fault	
	33.	Line-To-Line (LL) Fault	
	34.	Double Line- To-Ground (LLG) Fault	
	35.	Open Conductor Faults	
	36.	Numerical	
	37.	Numerical	
	38.	Numerical	
	39.	Numerical	
	40.	Numerical	
V	41.	**Power System Stability:** Introduction	**20**
	42.	Dynamics of a Synchronous Machine	
	43.	Review of power angle equations , Simple Systems	
	44.	Steady State Stability, Transient Stability	
	45.	Equal Area Criterion	
	46.	Factors Affecting Transient Stability	
	47.	Multi machine stability studies, classical representation	
	48.	Numerical	
	49.	Numerical	
	50.	Numerical	

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: Model Questions on modeling of PS	Students do power system modeling & get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity. Written solution expected.	Text Book 1, additional reference 1,2
2	Assignment 2: Model Questions on 3phase symmetrical faults	Students study 3ph-symmetrical faults & get practice to solve university questions.	Module 2 of the syllabus	4	Individual Activity. Written solution expected.	Text Book 1, additional reference 1,2

3	Assignment 3: Model Questions on sequence impedances and networks	Students learn to use sequence impedances & networks, get practice to solve university questions.	Module 3 of the syllabus	6	Individual Activity. Written solution expected.	Text Book 1, additional reference 1,2
4	Assignment 4: Model Questions on unsymmetrical problems	Students study the unsymmetrical faults & get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity. Written solution expected.	Text Book 1, additional reference 1,2
5	Assignment 5: Model Questions stability	Students learn stability of PS & get practice to solve university questions.	Module 5 of the syllabus	10	Individual Activity. Printed solution expected.	Text Book 1, additional reference 1,2

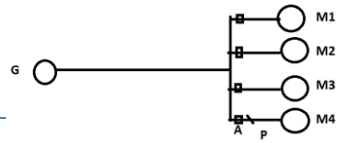
14.0 QUESTION BANK

Module I (Representation of power system components)

1. What is reactance diagram?
2. What is Per Unit of a quantity? Illustrate by example.
3. Define per unit quantity & mention advantages of per unit system.
4. Show that Per Unit impedance of a transformer is same on either side of it.
5. Explain change of base quantities.
6. Write the advantages of per unit computations.
7. With an suitable examples explain one line diagram & discuss the elements represented.
8. What is single line diagram? Hence, explain the procedure of finding reactance diagrams, by listing all the assumptions individual.
9. Define per unit quality. Mention the advantages of P.U system.
10. Show that per unit impedance of a transformer remains same on both primary & secondary sides.
11. State the rule of inspection for finding bus admittance matrix, giving the expression for the matrix elements. Also indicate the situations where in this rule is not applicable.
12. A 300 MVA, 20KV 3-phase generator has a sub-transient reactance of 20%. The generator supplies two synchronous motors over a transmission line 64Km long. The rated input to the motor are 200MVA,& 100MVA respectively. The motors have a sub-transient reactance of 20%each. The 3-phase transformer T1 is rated 350MVA, 230Y/20Δ KV with leakage reactance of 10%. The transformer T2 is composed of three, 1-phase transformers connected as 3-phase, Y-Δ bank & each rated 100MVA, 127/13.2KV with leakage reactance of 20% each. The reactance of transmission line is 0.5Ω/Km. Draw the P.U. reactance diagram of the power system, selecting the generator rating as base in the generator circuit. If the motors M1 &M2 have outputs of 120MW &60MW respectively at 13.2 KV & both operating at u.p.f. find the voltage at the terminals of the generator.

Module II (Symmetrical fault analysis)

1. Show that the subtransient reactance of the synchronous machine is the smallest and the steady state reactance of the machine is highest among all the reactance's. i.e X"d < Xd'< Xd
2. Write about selection of circuit breakers.
3. Write about transients on a transmission line due to short circuit.
4. Explain the analysis of three-phase symmetrical faults by Kirchoffs laws
5. Explain symmetrical fault analysis by Thevenin's Theorem.
6. With the help of oscillagrams of short circuit current, of a synchronous generator, operating on no load, distinguish between sub-transient, transient & steady state periods. Also write the corresponding equivalent circuits, which are used in computing Xd", Xd' & Xd.
7. Explain why with reference to a synchronous machine, Xd"< Xd' < Xd with usual rotations.
8. Write a note on the selection of circuit breakers.
9. A 25MVA, 11Kv generator with Xd"=20% is connected through a transformer, line & a transformer to a bus. The load at bus consists of 3 motors each having Xd"=25% & Xd'=30% on a base of 5MVA, 6.6Kv. Transformer T1 is rated 25MVA,11/66kv with a leakage reactance of 10% & transformer T2 is rated 25MVA, 66/6.6KV with a leakage reactance of 10%. The bus voltage at the motor is 6.6kv. When a 3-phase fault occurs at F for the specified fault
   Compute:
   i)subtransient current in the fault



ii)subtransient current in the breaker B
iii)Current to be interrupted by the breaker B in five cycles

10. A synchronous generator and motor are rated 30MVA, 13.2 kV and both have subtransient reactance of 20%. The line connecting them has a reactance of 10% on the base of the machine ratings. The motor drawing 20MW at 0.8 p.f leading and a terminal voltage of 12.8kV, when a symmetrical three phase fault occurs at the motor terminals. Find the subtransient current in the generator, motor and the fault by using internal voltages of the machines.

Module III (Symmetrical Components)

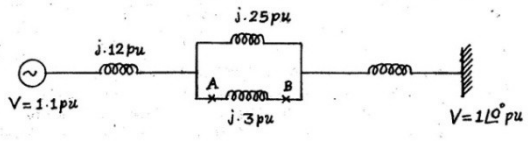
1. With the help of relevant vector diagrams for voltages establish the phase shift of symmetrical components in Y-Δ transformer bank.
2. Derive an expression for the 3Φ complex power in terms of symmetrical components.
3. What are symmetrical components? How they are useful in solution of power system.
4. What are sequence impedances and sequence networks?
5. Draw the zero sequence networks for various winding configurations of transformer.
6. Explain what symmetrical components are & how they are useful in solving the power system problems.
7. Write brief note on the significance of the operator "a".
8. Establishing the relation In = 3Iao with usual notations.
9. Prove that zero sequence component of currents only, flow through neutral.
10. Show that the symmetrical component transformation is power invariant.
11. Discuss on the phase shift of currents or voltages in Y- Δ transformers.
12. Define sequence impedances & sequence networks. Hence, indicate the zero sequence diagrams for various primary & secondary winding connection of a 3- ø transformer.
13. Show that positive, negative sequence voltages & currents undergo a phase shift, in passing through Y-Δ transformer & the phase shift is dependent on labeling of terminals.
14. Three identical resistors are star connected. The magnitude of the voltage at the terminals are Vab=200V, Vbc=290V, Vca=250V. Determine the sequence components of line to neutral voltage of phase 'a'.
15. The sequence components of the line to neutral voltage of a 3-phase system are, Va1=100<0V, Vb2=(10-j15)V, Vco=j15V. Determine line to neutral voltages.

Module IV (Unsymmetrical fault analysis)

1. Derive an expression for fault current for LG fault on terminals of synchronous machine without Zf.
2. Derive an expression for fault current for LL fault on terminals of synchronous machine without Zf.
3. Derive an expression for fault current for LLG fault on terminals of synchronous machine with Zf.
4. Derive an expression for fault current for LG fault on Power system.
5. Write a note on open conductor faults on Power system.
6. Write a note on the significance of unsymmetrical fault analysis by symmetrical component transformation.
7. Define sequence impedances & sequence networks. Hence, indicate the zero sequence diagrams for various primary & secondary winding connection of a 3-ø transformer.
8. A single L-G fault occurs on phase 'a of an unloaded synchronous generator. Derive an expression for the fault current & for the post fault line to line voltages. Also prove that the equivalent circuit under fault conditions comprises of +ve, -ve & zero sequence networks in series.
9. Derive an expression for the fault current in terms of the sequence impedances & hence arrive at the connection diagram of sequence networks for a L-L fault at the terminals of a star connected generator.
10. A double line to ground fault occurs at the terminals of unloaded generator. Derive an expression for the fault currents, draw the connection of sequence networks.
11. A synchronous generator has its neutral ground through a reactance Xn. Zero sequence reactance of the generator is larger that the +ve & -ve sequence reactances.
12. Obtain expression for Xn such that SLG ault current is less than the 3-ø fault current.
13. Derive the expression for fault current if
    i) LG ii) LL iii) DLG
    fault occurs through a fault impedance Zf in a power system. Show the connections of sequence network to represent the fault.
14. Write a note on open conductor faults in power system.
15. A 30MVA,13.8Kv alternator has Xd"=15%, X2=15%, Xo=5%. The alternator supplies two motors over a transmission line having transformers at both ends. The motors have rated inputs of 20MVA & 10MVA. Both 12.5KV with 20% sub-transient reactance & X2=20%, & Xo=5%. The current limiting reactors of 2.0 Ω each are in the neutral of the alternator & the larger motor. The 3-phase transformers are both rated 35MVA, 13.2Δ/115Y KV, with leakage reactance of 10% Series reactance of line is 80 Ω The zero sequence reactance of line is 200 Ω. Determine the fault current when i)L-G fault ii)L-L fault & iii)L-L-G fault takes place at point P on transmission line near transformer T1. Assume Vpf=1KV.

Module V (Power system stability)

1. Derive an expression for the swing equation.
2. Explain the terms: 1) Steady state stability ii) Transient stability and iii) dynamic stability as applied to power systems.
3. Derive a power angle equation for a non salient pole machine.
4. Explain the equal area criteria.
5. Discuss the methods of improving transient stability
6. Define inertia constant M&H for a synchronous machine. How they relate to each other?
7. What are the assumptions made in stability studies? How do you justify them?
8. Distinguish between steady state stability limit &transient limit.
9. Derive the power angle equation of a salient pole synchronous machine connected to an infinite bus. Draw the power angle curve.
10. Derive swing equation with usual notations.
11. Write a note on equal area criterion of stability.
12. A 4pole , 50 Hz 60 MW 0.8pf lag generator with a moment of inertia 30000kg-m2 is connected through a short line to another 2 pole, 50 Hz, 80MW, 0.85pf lag generator with moment of inertia 10000kg-m2. Determine the inertia constant of the equivalent single machine on a base of 20 MVA.
13. Determine the critical clearing angle for the network shown in fig, when a 3-phase fault takes place at B and the breaker at A and B operate simultaneously. The generator is delivering 1 pu power before fault takes place. Assume the inertia constant H=4.0



14. An a.c. generator is delivering 50% of maximum power to an infinite bus. Due to a sudden short circuit, the reactance between generator & infinite bus increases to 300% of the value before fault. The maximum power that can be delivered after clearance of fault is 70% of the original maximum value. Calculate the critical clearing angle to maintain the stability of the system.

Prepared by	Checked by		
	31/03/23	31/3/23	
Prof. Sujata G Huddar	**Prof. H R Zinage**	**HOD**	**Principal**

Course	**DIGITAL SIGNAL PROCESSING**		
Course Code	18EE63	**CIE Marks**	40
No of Lecture Hrs /week(L:T:P)	3:2:0	**SEE Marks**	60
Total Number of Lecture Hrs	50	**Exam Hours**	03
		CREDITS – 04	

FACULTY DETAILS:		
Name: Prof. A. U. Neshti	**Designation:** Asst.Professor	**Experience:** 14 years
No. of times course taught:03	**Specialization:** Digital Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical and Electronics Engineering	V	Signals and Systems
02	Electrical and Electronics Engineering	V	Linear IC's and applications

2.0 Course Objectives

1. To define Discrete Fourier, transform and its properties.
2. To evaluate DFT of various signals using properties of DFT.
3. To explain different linear filtering techniques.
4. To explain the evaluation of DFT and inverse DFT using fast and efficient algorithm
5. To discuss impulse invariant transformation, bilinear transformation techniques and their properties.
6. To design infinite impulse response Butterworth digital filters using impulse invariant and bilineartransformation techniques.
7. To design infinite impulse response Chebyshev digital filters using impulse invariant and bilineartransformation techniques.
8. To discuss direct, cascade, parallel and ladder methods of realizing a digital IIR filter.
9. To discuss window functions used for the design of FIR filters.
10. To discuss windowing technique of designing FIR filter.
11. To discuss frequency sampling technique of designing FIR filter.
12. To discuss direct, cascade and linear phase form of realizing a digital FIR filter.

3.0 Course Outcomes

The student, after successful completion of the course, will be able to:

	Course Outcome	Cognitive Level	
C312.1	Evaluate the DFT of various signals using its properties and linear filtering of two sequences.	L1-L4	PO1,PO2,PO3, PO8,PO9,PO12
C312.2	Apply fast and efficient algorithms for computing DFT and inverse DFT of a given sequence.	L1-L4	PO1,PO2,PO3, PO8,PO9,PO12
C312.3	Design digital IIR filters by using different transformation techniques.	L1-L4	PO1,PO2,PO3, PO8,PO9,PO12
C312.4	Design digital FIR filters using different sampling techniques.	L1-L4	PO1,PO2,PO3, PO8,PO9,PO12
C312.5	Model digital filters using different realization methods.	L1-L4	PO1,PO2,PO3, PO8,PO9,PO12
Total Hours of instruction		**50**	

4.0 Course Content

Module-1

Discrete Fourier Transforms: Definitions, properties-linearity, shift, symmetry Properties- circular convolution – periodic convolution, use of tabular arrays, circular arrays, Stock ham's method, linear convolution – two finite duration sequence, one finite & one infinite duration, overlap add and save methods**.**

Module-2

Fast Fourier Transforms Algorithms : Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithms, Inverse radix – 2 algorithms.

Module-3

Design of IIR Digital Filters: Introduction, impulse invariant transformation, bilinear transformations, All pole analog filters - Butterworth & Chebyshev filters, design of digital Butterworth filter by impulse invariant transformation and bilinear transformation, Frequency transformations.

Module-4

Design of IIR Digital Filters (Continued): Design of digital Chebyshev –type 1filter by impulse invariant transformationand bilinear transformation, Frequency transformations.
Realization of IIR digital systems: direct form, cascade form and parallel form, Ladder structures for equal degree polynomial.

Module-5

Design of FIR Digital Filters: Introduction, windowing, rectangular, modified rectangular. Hamming, Hanning, Blackman window, design of FIR digital filters by use of windows, Design of FIR digital filters-frequency samplingtechniques.
Realization of FIR systems: direct form, cascade form, linear phase form.

5.0 Relevance to future subjects

Sl.no	Semester	Subject	Topics
01	VIII	Project work	Automation

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Digital photo cameras, MP3 players to automobiles.
02	Speech processing, image processing
03	Applications of audio processing

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	NPTEL	Topic: DSP Processors

8.0 Books Used and Recommended to Students

Text Books
1. Introduction to Digital Signal Processing, Jhonny R. Jhonson, Pearson, 1st Edition, 2016.
Reference Books
1. Digital Signal Processing – Principles, Algorithms, and Applications, Jhon G. Proakis, Dimitris G. ManolakisPearson 4th Edition, 2007. 2. Digital Signal Processing A.NagoorKani McGraw Hill, 2nd Edition, 2012. 3. Digital Signal Processing, Shaila D. Apte, Wiley ,2nd Edition, 2009, 4. Digital Signal Processing, Ashok Amberdar, Cengage, 1stEdition, 2007 5. Digital Signal Processing Tarun Kumar Rawat Oxford 1st Edition, 2015
Additional Study material & e-Books
1) P.Ramesh Babu"Digital Signal Processing", Sitech publication 2003 2) "Digital Signal Processing" A Simplified approach by Dr. D Ganesh Rao & V P Gejji

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

Website and Internet Contents References
1) https://www.tutorialspoint.com/digital_signal_processing/index.html 2) www.bores.com/courses/intro/basics/1_whatis.html

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	Elsvier Journal	https://www.journals.elsevier.com/digital-signal-processing/
2	ICGST Journal of Digital signal processing	http://www.icgst.com/journals/journal.aspx?subid=45
3	International Journal of Advancements in Digital SignalProcessing	http://journals.theired.org/ijdsp.html
4	Science Direct	http://www.sciencedirect.com/science/journal/10512004

11.0 Examination Note

Continuous Internal Assesment: 40 Marks (50 Marks scaled down to 30 Marks Internal Assessment +10 Marks Assignment)

Internal Assessment is conducted for 50 Marks.
Scheme of Evaluation for Internal Assessment (50 Marks)
Student has to answer two full questions as per the format shown below.

Q.1 a	**25**	**Q.3 a**	**25**
b		**b**	
OR		**OR**	
Q.2 a	**25**	**Q.4 a**	**25**
b		**b**	

SCHEME OF EXAMINATION (60 Marks):

1. The question paper will have ten questions.
2. Each full question is for 20 marks.
3. There will be 2 full questions (with a maximum of four sub questions in one full question) fromeach module.
4. Each full question with sub questions will cover the contents under a module.
5. Students will have to answer 5 full questions, selecting one full question from each module

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1	1	Introduction, Definitions	20
	2	Properties-linearity, shift, symmetry etc	
	3	circular convolution – periodic convolution	
	4	Use of tabular arrays, circular arrays	
	5	Stock ham's methods- Examples	
	6	linear convolution – two finite duration sequence	
	7	one finite & one infinite duration with examples	
	8	overlap add methods with examples	
	10	overlap save methods with examples	
2	11	Introduction to Fast Fourier Transform algorithms	20
	12	Decimation in time algorithm with examples	
	13	Examples	
	14	first decomposition, number of computations	
	15	Examples	
	16	continuation of decomposition, number of multiplications	
	17	computational efficiency with examples	
	18	decimation in frequency algorithms with example	
	19	Inverse radix-2 algorithm.	
	20	Examples	
3	21	Introduction	20
	22	Impulse invariant transformation	
	23	Examples	
	24	Bilinear transformations	
	25	All pole analog filters - Butterworth & Chebyshev filters	
	26	design of digital Butterworth filter by impulse invariant transformation and bilinear transformation	
	27	Examples	
	28	Examples	
	29	Frequency transformations.	
	30	Examples	
4	31	Design of digital Chebyshev –type 1 filter by impulse invariant transformation and bilinear transformation	20
	32	Examples	
	33	Examples	
	34	Frequency transformations	
	35	Realization of IIR digital systems	
	36	direct form, cascade form and parallel form	
	37	Examples	
	38	Examples	
	39	Ladder structures for equal degree polynomial	
	40	Examples	
5	41	Design of FIR Digital Filters, Introduction	20
	42	windowing, rectangular, modified rectangular.	
	43	Hamming, Hanning, Blackman window	
	44	design of FIR digital filters by use of windows	
	45	Examples	
	46	Design of FIR digital filters-frequency sampling techniques	
	47	Examples	
	48	Realization of FIR systems: direct form, cascade form, linear phase form	
	49	Examples	
	50	Examples	

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 Discrete fourier trasform properties, circular convolution, periodic convolution.	Students Understand how DFT and IDFT methods are used to implement Linear convolution	Module 1 of the syllabus	2	Individual Activity.	Book 1, 2 of the reference list.
2	Assignment 2: University Questions on DIF and DIT-FFT algorithms.	Students study the importance of Twiddle factor to reduce the DFT computations.	Module 2 of the syllabus	4	Individual Activity.	Book 1, 2 of the reference list.
3	Assignment 3: University Questions on Design of analog Butterworth low pass filter and Chebyshev lowpass filter	Students study the steps to design digital filter	Module 3 of the syllabus	6	Individual Activity.	Book 1 of the reference and additional reference list.
4	Assignment 4: University Questions on design Of FIR digital filters	Students study the design of window based FIR filter.	Unit 4 of the syllabus	8	Individual Activity.	Book 1 of the reference and additional reference list.
5	Assignment 5: University Questions on Realization of IIR/FIR digital systems	Realization of IIR digital systems using direct form, cascade form and parallel form	Unit 4 and 5 of the syllabus	10	Individual Activity.	Book 1 of the reference and additional reference list.

14.0 QUESTION BANK

Module 1: Discrete Fourier Transforms

1) State and prove time shifting property of DFT.
2) Explain how the DFT can be used to compute N equispaced samples of the Z-transform of an N-point Sequence, on a circle of radius r.
3) Using Overlap-save method compute y (n) of a FIR filter with impulse response h (n) = {3, 2, 1} and input x(n)={2,1,-1,-2,-3,5,6,-1,2,0,2,1}.Use only 8 point circular convolution in your approach.
4) Compute circular convolution of two given sequences $x_1(n)=(2,1,2,1)$,$x_2(n)=(1,2,3,4)$using DFTand IDFT method.
5) For the given sequence $x_1(n) = \{1,2,3,1\}$,$x_2(n) = \{4,3,2,2\}$. Find $x_3(n)$ = such that $X3(k) = X_1(k).X_2(k)$.
6) Find $x_3(n)$ using DFT and IDFT method for the given $x_1(n) = \{1,1,2,1\}$, $x_2(n) = \{1,2,3,4\}$
7) Consider sequence $x_1(n) = \{0,1,2,3,4\}$,$x_2(n) = \{0,1,0,0,0\}$.Determine a sequence y(n) so that$Y(k) = X_1(k) . X_2(k)$
8) Find the 4 point circular convolution of the sequence $x_1(n) = \{1,2,3,1\}$,$x_2(n) = \{4,3,2,2\}$ using thetime domain approach and verify the result using frequency domain approach**.**
9) Compute the 4 point DFT of the sequence $x(n) = \{1,0,1,0\}$.Also find y(n) if $Y(k) = X((k-2))_4$
10) Suppose that we are given a program to fin the DFT of a complex-valued sequence x(n). How canwe use this program to find the inverse DFT of X(k).
11) Consider the sequence x1(n)= {0,1,2,3,4},x2(n) ={0,1,0,0,0},s(n)={1,0,0,0,0} and their pointDFT's
    i) Determine a sequence y(n) so that y(k)=x1(k).x2(k)
    ii) Is there a sequence x3(n) such that s(k)=x1(k).x2(k)?
12) A long sequence x(n) is filtered though a filter the impulse response h(n) to yield the output y(n),ifx(n) ={1,1,1,1,1,3,1,1,4,2,1,1,3,1},h(n)={1,-1}.Compute y(n) using overlap save techniques.
13) Compare linear convolution and circular convolution.

14) Compute the linear convolution of the sequences x1(n)={1,2,3,1} and x2(n)= {4,3,2,2} usingcircular convolution.
15) Define DFT. Derive the relationship of FT to i) the DTFT ii) the z transform.
16) A long sequence x(n) is filtered through a filter with impulse response h(n) to yield the output y(n). If h(n)=(1,2), x(n) =(1,4,3,0,7,4,-7,-7,-1,3,4,3), compute y(n), using the Overlap-add method. Use onlya 5- point circular convolution.
17) Find DFT of a sequence x(n) = (1,1,0,0) and also find IDFT of Y(k) = (1,0,1,0).
18) State and Prove the Periodicity and Linearity property of DFT.
19) The two sequences $x_1(n)$ and $x_2(n)$ are given as follows $x_1(n)$ =(2,1,2,1) and $x_2(n)$ = (1,2,3,4). Findout sequence x3(n) which is equal to circular convolution of above two sequences
$x_3(n) = x_1(n) \text{O} x_2(n)$. and verify the result using matrix multiplication method.
20) State and Prove Parseval's Theorem.
21) If x(n) = X(k) then show that DFT$[x((-n))_N] = X((-k))_N$
22) For the given sequence $x_1(n)$ = {1,2,3,1},$x_2(n)$ = {4,3,2,2}. Find $x_3(n)$ = such that$X_3(k) = X_1(k).X_2(k)$
23) Compute the 4 point DFT of the sequence x(n) = {1,0,1,0}.Also find y(n) if Y(k) = $X((k-2))_4$
24) Find the 4 point circular convolution of the sequence $x_1(n)$ = {1,2,3,1},$x_2(n)$ = {4,3,2,2} using the time domain approach and verify the result using frequency domain approach.
25) Compute IDFT of the sequence X(k) = (2,1+j,0,1-j)
26) For the given sequence $x_1(n)$ = {1,1,1,1},$x_2(n)$ = {2,2,2,2}. Find $x_3(n)$ = such that$X_3(k) = X_1(k).X_2(k)$.

Module 2: Fast Fourier transform algorithm

1) What are the properties of phase factor (W_N) that are exploited in fast fourier transform algorithms?
2) Develop decimation in time (DIT) FFT algorithm with all necessary steps and neat signal flowdiagram for N-point DFT.
3) What is FFT? Explain Radix-2 DIT-FFT algorithm.
4) Develop DIF-FFT algorithm with all necessary steps and neat signal flow diagram used in computing N- point DFT, X(k) of a N-point sequence x(n).Using the same. Compute the DFTsequence x(n)={1,1,1,1,1,1,1,1}.
5) Derive Radix-2 DIF FFT algorithm to compute DFT of a N=8 point sequence and drawthe complete signal flow graph.
6) Find the sequence x(n) corresponding to the 8 point DFT X(k)={4,1-j2.414,0,1-j0.414,0,1+j0.414,01+j2.414} by using any of the Radix-2 FFTalgorithms to compute IDFT.
7) Determine 4 point IDFT of X(k)={2.5,-0.25+j0.75,0,-0.25-j0.75} using DIFFFT algorithm.
8) How many complex multiplications are required for direct computation of 64 point DFT?What is its value if FFT is used?
9) Determine 8 point DFT of x(n) = {1,0,-1,2,1,1,0,2} using radix-2 DIT-FFT algorithm. Show clearlyall the Intermediate results.
10) Why FFT is needed? What is the speed improvement factor in calculating 64 point DFT of asequence using direct computation and FFT algorithm.
11) What are the differences and similarities between DIT and DIF FFT algorithm?
12) Develop DITFFT algorithm for decomposing the DFT for N=6 and draw the flow diagrams forN= 2x3.
13) If x1(n) =[1,2,0,1] and x2(n) = [1,3,3,1], Obtain x1(n)©x2(n) using DIT-FFT algorithm.
14) Find the 4 point DFT of the following sequences, using a single 4 point DFTx1(n) =[1,2,0,1] and x2(n)= [2,2,1,1].
15) Compute number of complex multiplications for the direct evaluation of DFT v/s FFT algorithm forN=4,16,64,256 also find the speed improvement factor.
16) Find the 8 point DFT of the given sequence x(n). X(n)=(0,1,2,3,4,5,6,7)
17) Compute 8 point DFT of the sequence x(n)=(11111111) using DIT, DIF algorithm. 18) Compute IDFT of the sequence X(k)={4,1-j2.414,0,1-

j0.414,0,1+j0.414,0,1+j2.414}

19) Determine 8 point DFT of x(n) = {1,0,-1,2,1,1,0,2} using radix-2 DIT-FFT algorithm.Show clearly all the intermediate results.

20) Find the DFT of a sequence x(n)={1,2,3,4,4,3,2,1} using DIT algorithm.

21) Compute 4-point DFT of a sequence x(n)={0,1,2,3} using DIT algorithm.

22) Develop DIT-FFT algorithm for N=9=3x3 and draw the complete signal flow graph. A 9 point realvalued sequence is given by x(n)={0,1/4,1/2,3/4,1,3/4,1/2,1/4,0}

23) Find the DFT of a sequence x(n)={1,1,1,1,1,1,1,1} using DIT algorithm.

Module 3: Design of IIR Digital filters

1) Transform the analog filter H(s) = (s+3)/(S+1)(s+2) to a digital filter using the matched z transform. LetT=0.5 sec.

2) Using the bilinear transformation S= $(1- z^{-1})/ (1+z^{-1})$ .What is the image of $S=e^{j}$ /2 in the Z-plane.

3) Determine the order of Butterworth and Chebyshev approximation analog filters used to meet the following specification: passband attenuation of 1dB at 4kHz and stop band attenuation of 40B at6 kHz.

4) Design a chebyshev type I analog filter to meet the following specification: pass band attenuation2 dB at 4 rad/sec and stop band attenuation of 10 dB at 7 rad/sec.

5) Write a short note on bilinear transformation.

8) Compare FIR versus IIR filters.

9) Design a analog filter which has equiripple characteristics in passband minitoni8c falloff characteristics in stop band given maximum passband attenuation of 2.5dB at Ωp= 20 rad/sec and the stop band attenuation of 30 dB at Ωs =30 rad/sec. Transform the analog filter to digital filter using impulse invariance method.

10) Transform the analog filter $H(s) = (s+0.1)^2/(s+0.1)^2+9$ to H(Z) using the impulse invariance transformation.

11) For the given specification α_p=1 dB, α_s=30 dB, Ωp=200 rad/sec, Ωs=600 rad/sec. Determine the order of low pass Butterworth filter.

Module 4: Design of IIR Digital filters(Continued)

1) Compare Digital filter with Analog filter. Also explain the advantages and disadvantages of digital filter.

2) For the given specifications α_p= 3dB, α_s= 16 dB, fp=1 kHz and fs=2kHz. Determine the order of filter using Chebyshev type-I approximation. Also Find H(s).

3) For the analog transfer function H(s)=(2)/((s+1)(s+2)). Determine H(z) using impulse invariance method. Assume T=1 sec.

4) Using Bilinear transformation, design a high pass filter, monotonic in passband with cutoff frequency of 1000 Hz at α_P=3 dB and down to 10 dB at 350 Hz. The sampling frequency is 5000 Hz.

5) Determine direct form II realization for the following system y(n)=-0.1y(n-1)+0.72y(n-2)+0.7x(n)-0.252x(n-2).

6) Realize the system with difference equation y(n)=3/4y(n-1)-1/8y(n-2)+x(n)+ 1/3x(n-1) in cascade form.

7) Obtain the direct form I, direct form II, cascade and parallel form realization for the following system y(n)= -0.1y(n-1)+0.2 y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2).

8) Draw the direct form II, cascade and parallel form structure for the following system $H(z)= (1-3/4z^{-1}+1/8z^{-1})/(1+z^{-1}+2/9z^{-2})(1+1/4z^{-1})$

9) Obtain a parallel realization for the following $H(z)= (8z^3-4z^{-2}+11z-2)/(z-1/4)(z^{-2}-z+1/2)$

Module 5: Design of FIR Digital filters

1) Show that if the impulse response has the even symmetry then FIR filter possesses linear phase

Characteristics. Comment on position of zero on the Z-plane

2) Explain the frequency sampling method of designing FIR filters and draw the corresponding block diagram
3) Explain the structures used for realizing FIR filters by illustrations.
4) Show that the roots of H(z) occur in reciprocal pair for a linear phase FIR filter.
5) Consider a FIR filter with system function:
   $H(z) = 1+2.82\ z^{-1}+3.4048\ z^{-2}+1.74\ z^{-3}$. Sketch the direct form and lattice realization of the filter.
6) Write a short note on window-based Fir filter design.
7) Write short notes on Butterfly operation and in place computation.
8) What are advantages and disadvantages ith design of FIR filters using window function?
9) The frequency response of a linear phase Fir filter is given by
   $H(e^{jw}) = e^{j3w}[2+1.8\ co\ 3w+1.2\ cos2w+0.5cosw]$.Find the impulse response sequence of the filter.
10) What condition on the Fir sequence h(n) are to be imposed in order that the filter can be called a linear phase filter.
11) Discuss design method of FIR filters

Prepared by	Checked by		
23/3/23	23/3/2023	23.3.23	
Prof. A. U. Neshti	**Prof. M. P. Yenagimath**	**HOD**	**Principal**

Subject Title	ELECTRICAL ENGINEERING MATERIALS		
Subject Code	18EE642	**CIE Marks**	40
Number of Lecture Hrs / Week	04	**SEE Marks**	60
Total Number of Lecture Hrs	40	**Exam Hours**	03
			CREDITS – 03

FACULTY DETAILS:		
Name: Prof. K B Negalur	**Designation:** Asst. Professor	**Experience:** 09 Years
No. of times course taught: 04	**Specialization:** Industrial Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical &Electronics Engineering	I/II	Basic Electrical Engineering
02	Electrical &Electronics Engineering	I/II	Basic Electronics Engineering
03	Electrical &Electronics Engineering	III	Machines, Transformers and Generators
04	Electrical &Electronics Engineering	IV	Transmission and Distribution

2.0 Course Objectives

- To impart the knowledge of conducting, dielectric, insulating and magnetic materials and their applications.
- To impart the knowledge of superconducting materials and their applications.

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
CO314.1	Discuss electrical and electronics materials, their importance, classification and operational requirement	L1, L2	1,2,3,8,12
CO314.2	Discuss conducting, dielectric, insulating and magnetic materials used in engineering, their properties and classification.	L1, L2	1,2,3,8,12
CO314.3	Explain the phenomenon superconductivity, super conducting materials and their application in engineering	L1, L2	1,2,3,8,12
CO314.4	Explain the plastic and its properties and applications	L1, L2	1,2,3,8,12
CO314.5	Explain the plastic and mention their properties and applications and also discuss materials used for Opto electronic devices.	L1, L2	1,2,3,8,12
Total Hours of instruction		**40**	

4.0 Course Content

MODULE 1

Introduction to Electrical and Electronic Materials: Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, Requirement of Engineering materials, Operational requirements of electrical and electronic materials, Classification of solids on the basis of energy gap, Products – working principle and materials, Types of engineering materials, Levels of material structure. Spintronics and Spintronic materials, Ferromagnetic semiconductors, Left handed materials.

Conductors: Conductor materials, Factors affecting conductivity, Thermal conductivity, Heating effect of current, Thermoelectric effect, Seebeck effect, Thomson effect, Wiedemann – Franz law and Lorentz relation, Problems. 08**Hours**

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding.

MODULE2

Conductive Materials and Applications: Mechanically processed forms of electrical materials, Types of conducting materials, Low resistivity materials, High resistivity materials, Contact materials, Fusible materials, Filament materials, Carbon as filamentary and brush material, Material for conductors, cables, wires, solder, sheathing and sealing.

Dielectrics: Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss. Polarization, Mechanisms of polarization, Comparison of different polarization process, Factors affecting polarization, Spontaneous polarization, Behaviour of polarization under impulse and frequency switching, Decay and build-up of polarization under ac field, Complex dielectric constant. 08**Hours**

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding.

MODULE 3

Insulating Materials: Insulating materials and applications – Ceramic, Mica, Porcelain, Glass, Micanite and Glass bonded mica. Polymeric materials – Bakelite, Polyethylene. Natural and synthetic rubber. Paper. Choice of solid insulating material for different applications, Liquid insulating materials – Requirements, Transformer oil, Bubble theory, Aging of mineral insulating oils. Gaseous insulating Materials – Air, Nitrogen, Vacuum.

Magnetic Materials: Origin of permanent magnetic dipole, Magnetic terminology, Relation between relative permeability and magnetic susceptibility. Classification of magnetic materials, Diamagnetic, Paramagnetism, Ferromagnetism, Antiferromagnetism and the corresponding materials. Ferrimagnetism and ferrites – properties and applications, Soft and hard ferrites. Curie temperature, Laws of magnetic materials. Magnetization curve, Initial and maximum permeability. Hysteresis loop and loss, Eddy current loss. 08 **Hours**

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding.

MODULE4

Magnetic Materials (continued): Types of magnetic materials, Soft and hard magnetic materials, High energy magnetic materials, Commercial grade soft and hard magnetic materials.

Superconductive Materials: Concept of superconductors, Meaning of phenomenon of superconductivity, Properties of superconductors, Types of superconductors, Critical magnetic field Superconductive Materials (continued):and critical temperature, Effects of Isotopic mass on critical temperature, Silsbee rule, Depth of penetration and coherence length. Ideal and Hard superconductors, Mechanism of super conduction, London's theory for Type I superconductors, GLAG theory for Type I superconductors, BCS theory, Applications and limitations. Applications of high temperature superconductors, Superconducting solenoids and magnets, MRI for medical diagnostics. 08 **Hours**

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding.

MODULE 5

Plastics: Introduction, Thermoplastics, Rubbers, Thermosets, DC and AC properties, Mechanical properties and processing of plastic.

Materials for Opto–Electronic Devices: Introduction, Optical phenomena, Reflection, Refraction, Transmittivity, Scattering, Optical absorption, Optical properties of non-metals, Optical properties of metals, Optical properties of semiconductors, Optical properties of insulators. Luminescence, Opto – Electronic devices, Photoconductivity, Photoconductive cell. 08 **Hours**

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	III & VI	Electrical and Electronic Measurements, Power Generation and Economics, Electric Motors	Machine, Equipment, components or devices etc
02	V	Power Electronics & Special Electrical Machines	Machine, Equipment, components or devices etc

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Basic Electrical
02	Electric Motors, Electrical and Electronics Measurement, Power Electronics, Sensors and Transducers.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Assignment problems will be solved in the tutorial classes to clear the concepts.
02	NPTEL	Explained with Video Lectures will be used to clear the concepts

8.0 Books Used and Recommended to Students

Text/Reference Books				
1	Advanced Electrical and Electronics Materials; Processes and Applications.	K.M. Gupta Nishu Gupta	Wiley	First Edition, 2015
2	Electronic Engineering Materials	R.K. Shukla Archana Singh	McGraw Hill	2012
3	Electrical Properties of Materials	L Solymar et al	Oxford	9th Edition, 2014
4	Electrical Properties of Materials	A.J. Dekker	Pearson	2016
5	Principle of Electronic Materials and Devices	S.O. Kasap	McGraw Hill	3rd Edition 2010

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

Website and Internet Contents References
1. NPTEL Videos 2. www.wikipedia.com

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	Electronics for you	https://electronicsforu.com/
2	Newelectronics	http://www.newelectronics.co.uk/digital-magazine/

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: 50 Marks scaled down to 30 marks
Assignment marks: 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 four 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 No.	Lect. No.	Content of Lecture	% of Portion
I	1.	Importance of materials, Classification of electrical and electronic materials.	20
	2.	Scope of electrical and electronic materials.	
	3.	Requirement of Engineering materials, Operational requirements of electrical and electronic materials.	
	4.	Classification of solids on the basis of energy gap, Products – working principle and materials.	
	5.	Types of engineering materials.	
	6.	Levels of material structure. Spintronics and Spintronic materials.	
	7.	Ferromagnetic semiconductors, Left handed materials.	
	8.	Conductors: Conductor materials, Factors affecting conductivity, Thermal conductivity, Heating effect of current, Thermoelectric effect, Seebeck effect, Thomson effect, Wiedemann – Franz law and Lorentz relation, Problems.	
II	9.	Insulating Materials: Insulating materials and applications – Ceramic, Mica	20
	10.	Porcelain, Glass, Micanite and Glass bonded mica	
	11.	Polymeric materials – Bakelite & Polyethylene, Natural and synthetic rubber, Paper	
	12.	Choice of solid insulating material for different applications	
	13.	Liquid insulating materials its requirements	
	14.	Transformer oil & Bubble theory, Aging of mineral insulating oils.	
	15.	Gaseous insulating Materials – Air, Nitrogen, Vacuum.	
	16.	Magnetic Materials: Origin of permanent magnetic dipole	
III	17.	Magnetic terminology, Relation between relative permeability and magnetic susceptibility.	20
	18.	Classification of magnetic materials, Diamagnetic,	
	19.	Paramagnetism & Ferromagnetism,	
	20.	Antiferromagnetism and the corresponding materials.	
	21.	Ferrimagnetism and ferrites	
	22.	Properties and applications, Soft and hard ferrites	
	23.	Curie temperature, Laws of magnetic materials.	
	24.	Magnetization curve, Initial and maximum permeability, Hysteresis loop and loss,	

		Eddy current loss	
IV	25.	Magnetic Materials (continued):Types of magnetic materials, Soft and hard magnetic materials.	
	26.	High energy magnetic materials & Ideal and Hard superconductors	
	27.	Commercial grade soft and hard magnetic materials.	
	28.	Superconductive Materials: Concept of superconductors, Meaning of phenomenon of superconductivity.	
	29.	Properties of superconductors & Types of superconductors	
	30.	Critical magnetic field and critical temperature	
	31.	Effects of Isotopic mass on critical temperature, Silsbee rule, Depth of penetration and coherence length.	
	32.	Mechanism of super conduction, London's theory for Type I superconductors, GLAG theory for Type I superconductors, BCS theory, Applications and limitations	
V	33.	Introduction, Thermoplastics,	20
	34.	Thermosets, DC and AC properties	
	35.	Rubbers Mechanical properties, Processing of plastic	
	36.	Materials for Opto – Electronic Devices: Introduction, Optical phenomena	
	37.	Reflection, Refraction, Transmittivity, Scattering, Optical absorption	
	38.	Optical properties of non-metals, Optical properties of metals	
	39.	Optical properties of insulators. Luminescence, Optical properties of semiconductors	
	40.	Opto –Electronic devices, Photoconductivity, Photoconductive cell.	

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:Questions on importance of materials, Scope of electrical and electronics materials	Student will be able to understand the importance and scope of Electrical and Electronics materials.	Module-1	4	Individual	1,2
2	Assignment-2: Questions on understand the behavior of conductor and its properties.	Student will be able to understand the conductivity of materials.	Module-2	7	Individual	1,2
3	Assignment-3: Questions on insulator	Student will be able to understand various types of insulator and their properties.	Module-3	10	Individual	1
4	Assignment-4: Questions on Magnetic Materials	Student will be able to understand different magnetic materials.	Module-4	13	Individual	1
5	Assignment-5: Questions on Opto electronics.	Student will be able to understand Opto electronics.	Module-5	15	Individual	1

14.0 QUESTION BANK

MODULE-I

1. List the characteristics of good materials.
2. Explain the effect of temperature on electrical conductivity of metals.
3. Mention the desired properties and uses of low resistivity and high resistivity materials.
4. Explain different materials that can be used for lamp filaments.
5. Explain briefly the uses of following in electrical industry.
   A) Silver
   B) Aluminum C) Copper
6. Explain the different types of engineering materials.
7. Classify electrical and electronics engineering materials.
8. Discuss the Levels of material structure.
9. Short note on Spintronics and Spintronic materials.
10. Explain the factors affecting conductivity.
11. Discuss the concept of thermoelectric effect.

MODULE-II

1. Explain the effect of temperature on electrical conductivity of metals.\
2. What are the general properties of the conducting materials.
3. Explain the different types of semiconductors.
4. Obtain the expression for the conductivity of an intrinsic semiconductor.
5. Write a note on dielectric loss.
6. Explain the factors affecting polarization.
7. Explain briefly spontaneous polarization.
8. Write a short note on dielectric strength and dielectric constant.

MODULE-III

1. List the characteristics of good insulating materials.
2. What is polarization? What are the types.
3. What are the properties & applications of Mica and glass.
4. Bring out the differences between hard & soft magnetic materials.
5. Bring out the differences between hard & soft magnetic materials.
6. What is magnetostriction? Explain in brief.
7. Explain Polymeric materials - Bakelite & Polyethylene.

MODULE-IV

1. Explain the Effects of Isotopic mass on critical temperature.
2. Write short note on MRI for medical diagnostics.
3. Define spin-spin coupling.
4. Explain briefly about atomic absorption spectroscopy.
5. What is electron spin resonance? Mention its applications.
6. What is Superconductive? And explain concept of superconductors.
7. What is Critical magnetic field and critical temperature.

MODULE-V

1. What are plastics. List the classification of plastics.
2. Distinguish between the thermosetting and thermoplastics.
3. List the Optical properties of insulators.
4. List the Optical properties of non-metals.
5. What are the types of rubber and mention the applications of each type.
6. Short note on Opto –Electronic devices, Photoconductivity.

Prepared by	Checked by		
Prof. Keshav. Negalur	**Prof. A. U. Neshti**	**HOD**	**Principal**

Subject Title	**PROGRAMMING IN JAVA**		
Subject Code	**18CS653**	**IA Marks**	40
Number of Lecture Hrs / Week	03	**Exam Marks**	60
Total Number of Lecture Hrs	40	**Exam Hours**	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Prof. Prasanna Patil	**Designation:** Asst. Professor	**Experience:** 9.5 Years
No. of times course taught:01	**Specialization:** Computer Science and Engineering	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Computer Science and Engineering	I/II	CPS

2.0 Course Objectives

This course will enable students to

1. Learn fundamental features of object-oriented language and JAVA.
2. Set up a Java JDK environment to create, debug and run simple Java programs.
3. Learn object-oriented concepts using programming examples.
4. Study the concepts of importing packages and exception handling mechanisms.
5. Discuss the String Handling examples with Object Oriented concepts.

3.0 Course Outcomes

After studying this course, students will be able to

CO	Course Outcome	RBT Level	POs
C320.1	Explain the object-oriented concepts and JAVA.	L1, L2	1,2,3,8,10,12
C320.2	Develop computer programs to solve real world problems in Java.	L1, L2	1,2,3,8,10,12
C320.3	Develop simple GUI interfaces for a computer program to interact with users.	L1, L2	1,2,3,8,10,12
Total Hours of instruction		**50**	

4.0 Course Content

Module 1 (8 Hours)

An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and **Arrays:** Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings

Module 2 (8 Hours)**Operators:**

Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, **Control Statements:**Java‟s Selection Statements, Iteration Statements, Jump Statements.

Module 3 (8 Hours)

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, **A Closer Look at Methods and Classes:** Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited, **Inheritance:** Inheritance, Using super,

Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class.

Module 4 (8 Hours)

Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces, **Exception Handling:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions.

Module 5 (8 Hours)

Enumerations, Type Wrappers, I/O, Applets, and Other Topics: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, Applet Fundamentals, The transient and volatile Modifiers, Using instanceof, strictfp, Native Methods, Using assert, Static Import, Invoking Overloaded Constructors Through this( ), **String Handling:** The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String , Additional String Methods, StringBuffer, StringBuilder.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project work	Java

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Development of a software applications

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	
02	NPTEL	

8.0 Books Used and Recommended to Students

Text Books
1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,13,15)
Reference Books
1. Cay S Horstmann, "Core Java - Vol. 1 Fundamentals", Pearson Education, 10th Edition, 2016. 2. Raoul-Gabriel Urma, Mario Fusco, Alan Mycroft, "Java 8 in Action", Dreamtech Press/Manning Press, 1st Edition, 2014.
Additional Study material & e-Books
1. Programming in Javaby Balguruswamy

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

Website and Internet Contents References
1. www.nptelvideos.com/**java**/**java**_video_lectures_tutorials.php
2. https://www.cse.**iit**b.ac.in/~nlp-ai/**java**lect_august2004.html

3.	www.nptel.ac.in/courses/106105084/28

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	Java Magazine - Oracle	www.oracle.com/technetwork/java/javamagazine/
2	Java - IEEE Conferences, Publications, and Resources	https://www.computer.org/software-magazine/
3	Java Developer's Journal - Steven Gould	https://jserd.springeropen.com/

11.0 Examination Note

Internal Assessment: 30+10=40 Marks
30 marks –from three internal assessment test
10 marks- from the assignments
Scheme of Evaluation for Internal Assessment (30 Marks)
a) Internal Assessment test in the same pattern as that of the main examination (Average of the three Tests): 30 marks.
b) Assignment marks for each module is 25. Average of 5 assignment marks will be taken and finally scale down to 10 marks.

Question Paper Pattern (IA):
1. Two main questions to be set from syllabus covered up to IA tests.
2. Students have to answer two full main questions and each question carries 15 marks, Total test marks are 30.

a. Q.No I or Q.No II = 15 Marks
b. Q.No III or Q.No IV = 15 Marks
c. **Total = 30 Marks**

Question Paper Pattern and instructions (Main Exam):
1. The question paper will have TEN questions.
2. There will be TWO questions from each module.
3. Each question will have questions covering all the topics under a module.
4. The students will have to answer FIVE full questions, selecting ONE full question from each module.

Max. Marks: 100 and each question carries 20 marks.
Exam Duration: 3 Hrs.
5. The total marks scored out of 100 marks will be scaled down to 60 marks.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
MODULE 1	1	Object-Oriented Programming, A First Simple Program, A Second Short Program,	20%
	2	Two Control Statements, Using Blocks of Code, Lexical Issues,	
	3	The Java Class Libraries, Data Types, Variables	
	4	Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers	
	5	Floating-Point Types, Characters, Booleans, A Closer Look at Literals,	
	6	Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions,	
	7	Arrays	
	8	A Few Words About Strings	
MODULE 2	9	Operators: Arithmetic Operators	20%
	10	The Bitwise Operators,	
	11	Relational Operators, Boolean Logical Operators	
	12	The Assignment Operator, The ? Operator	
	13	Operator Precedence, Using Parentheses	
	14	Control Statements: Java's Selection Statements	
	15	Iteration Statements	
	16	Jump Statements.	
MODULE 3	17	Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables,	20%
	18	Introducing Methods, Constructors, The this Keyword,	
	19	Garbage Collection, The finalize( ) Method, A Stack Class,	
	20	A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects,	
	21	Recursion, Introducing Access Control, Understanding static, Introducing final	
	22	Arrays Revisited, Inheritance: Inheritance, Using super, Creating a Multilevel Hierarchy	
	23	When Constructors Are Called, Method Overriding, Dynamic Method Dispatch	
	24	Using Abstract Classes, Using final with Inheritance, The Object Class.	
MODULE 4	25	Packages, Access Protection, Importing Packages,	20%
	26	Interfaces,	
	27	Exception Handling: Exception-Handling Fundamentals, Exception Types, ,	
	28	Uncaught Exceptions, Using try and catch, Multiple catch Clauses,	
	29	Nested try Statements, throw, throws,	
	30	finally, Java's Built-in Exceptions,	
	31	Creating Your Own Exception Subclasses	
	32	Chained Exceptions, Using Exceptions.	
MODULE 5	33	I/O Basics, Reading Console Input, Writing Console Output,	20%
	34	The PrintWriter Class, Reading and Writing Files, Applet Fundamentals,	
	35	The transient and volatile Modifiers, Using instanceof, strictfp, Native Methods	
	36	Using assert, Static Import, Invoking Overloaded Constructors Through this( )	
	37	String Handling: The String Constructors, String Length, Special String Operations,	
	38	Character Extraction, String Comparison, Searching Strings	
	39	Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String	
	40	Additional String Methods, StringBuffer, StringBuilder.	

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: Some important University Questions on Module one.	Students study the Topics and write the Answers. Get practice to solve questions.	Module one of the syllabus	3	Individual Activity. Witten solutions expected.	Text book
2	Assignment 2: Some important University Questions on Module two	Students study the Topics and write the Answers. Get practice to solve questions.	Module two of the syllabus	6	Individual Activity. Witten solutions expected.	Text book
3	Assignment 3: Some important University Questions on module three.	Students study the Topics and write the Answers. Get practice to solve questions.	Module three of the syllabus	9	Individual Activity. Witten solutions expected.	Text book
4	Assignment 4: Some important University Questions and comprehensive questions on module four.	Students study the Topics and write the Answers. Get practice to solve questions.	Module four of the syllabus	11	Group Activity powerpoint presentation	Text book and reference books
5	Assignment 5: Some important University Questions and comprehensive questions on module five.	Students study the Topics and write the Answers. Get practice to solve questions.	Module five of the syllabus	13	Group Activity powerpoint presentation	Text book and reference books

14.0 QUESTION BANK

Module 1:

1 Explain the features of Java.
2 Elucidate how Java is a platform independent language, with neat sketches
3 List and explain Java buzzwords.
4 Explain the process of creating and running Java programs.
5 Explain the structure of a Java program and its keywords with an example.
6 Write & demonstrate a Java program to initialize & display different types of integers & floating type variables.
7 Explain different access specifiers in Java & their scope.
8 Define type casting. Explain with an example.
9 Explain type conversion, with an example.
10 What is type casting? Illustrate with an example. What is meant by automatic type promotion?
11 How are arrays defined in Java? Explain with an example.

Module 2:

1 Discuss operators in Java.
2 What is a jump statement? Explain with examples.
3 Explain : i) >>> ii)short circuit logical operators iii) for each
4 With an example explain the working of >> and >>> (unsigned right shift)
5 Write a Java program to print the factorial of the number ‘n’ using the “for” loop.
6 Write a program to calculate the average among the elements {8, 6, 2, 7} using “for each” in Java. How is “for each” different from “for” loop?

7 Write a Java program to sum only the first five elements of the array {1,2,3,4,5,6,7,8,9,10} using "for each" version of the for loop.
8 Write a java program to sum only first five elements of the array using for each looping.
9 Explain the operation of the following operators with examples. i) % ii) >>> iii) &&
10 How to declare two dimensional arrays in java? Explain with a simple example.
11 Write a Java program to illustrate the use of multidimensional arrays.

Module 3:

1 Define inheritance. List the different types of inheritance. (Jan-2018)
2 Discuss the following terms with an example: i) superii) final (Jan-2019)
3 Define inheritance. Explain the multilevel hierarchy with an example program,
4 Write a Java program to define an interface called Area which contains method called Compute( ) and calculate the areas of rectangle (ℓ * b) and triangle (1/2 * b * h) using classes Rectangle and Triangle.
5 With an example program explain the method overriding?
6 Compare and contrast method overloading and method overriding with suitable examples.
7 When constructors are called in the class hierarchy?
8 Distinguish between method overloading and overriding in Java, with suitable examples.

Module 4:

1 Explain the package and its types and import commands in Java with examples.
2 Describe the various levels of access protections available for packages and their implications.
3 Which is the alternative method to implement multiple inheritance in Java? Explain with an example.
4 Explain the role of interfaces while implementing multiple inheritance in Java.
5 Give the basic form of an exception handling block.
6 Define the role of Exception handling in software development.
7 What is an exception? Give an example for nested try statements.
8 Define exceptions. Explain the exception handling mechanism with an example.
9 Explain Java's built-in exceptions.
10 What is the importance of the clause finally?
11 Create a try block that is likely to generate three types of exception and incorporate necessary catch block to catch and handle them.
12 Write a Java program for illustrating the exception handling when a number is divided by zero and an array has a negative index value.

Module 5:

1 Write a note about a PrintWriter Class.
2 With a neat diagram, explain the life cycle of Applet.
3 Write a note on Native Methods.
4 Write a note on Special String Operations.
5 Write a note on StringBuffer.
6 Write a note on StringBuilder.

15.0 University Result

Examination	Total Students	PASS (P)	FAIL (F)	% Passing
2021 Feb/March	**41**	**40**	**01**	**97.5 %**
2022 July	**23**	**23**	**00**	**100%**

Prepared by	Checked by		
			
Prof. P. G. Patil	**Prof. M. G. Huddar**	**HOD**	**Principal**

Subject Title	**CONTROL SYSTEM LABORATORY**		
Subject Code	18EEL66	**CIE Marks**	40
Number of Practical Hours/Week(L:T:P)	0:02:02	**SEE Marks**	60
Total No of Practical Hrs	46	**Exam Hours**	03
			CREDITS – 02

FACULTY DETAILS:		
Name: Shri.O. B. Heddurshetti	**Designation:** Asst. Professor	**Experience:** 17Years
No. of times course taught: 04 Times	**Specialization:**Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electrical Engineering
02	Electrical & Electronics Engineering	IV	Electric Motors
03	Electrical & Electronics Engineering	VI	Control System

2.0 Course Objectives

- To determine the time and frequency domain responses of a given second order system using Software package or discrete components.
- To design and analyze Lead, Lag and Lag – Lead compensators for given specifications.
- To draw the performance characteristics of ac and dc servomotors and synchro-transmitter receiver pair.
- To study the DC position and feedback control system and to study the effect of P, PI, PD and PIDcontroller and Lead compensator on the step response of the system.
- To write script files to plot root locus, Bode plot, Nyquist plots to study the stability of the systemusing a software package.

3.0 Course Outcomes

The student, after successful completion of the course, will be able to

CO	Course Outcome	Cognitive Level	POs
C324.1	Determine the speed – torque characteristics of a D.C. and A.C. servomotor & Synchro pair characteristics.	L3	1,2,3,8,9, 10,12
C324.2	Determine time response characteristics of a second order system using MATLAB and frequency response characteristics of a second order system using MATLAB and experimental setup and evaluate time and frequency domain specifications.	L5	1,2,3,5,8, 9,10,12

C324.3	Design passive RC lead, lag, lead-lag compensating network for given specifications and determine the frequency response characteristics of the same using MATLAB and experimental setup.	L5	1,2,3,5,8, 9,10,12
C324.4	Determine the effect of P, PI, PD and PID controller on the step response of a feedback control system using MATLABand experimental setup.	L5	1,2,3,5,8, 9,10,12
C324.5	Demonstrate a DC position control system by using MATLAB and determine its step response.	L3	1,2,3,5,8, 9,10,12
C324.6	Examine the stability of a system by root locus, bode plot and Nyquist plot methods, verify and compare the same by using MATLAB.	L4	1,2,3,5,8, 9,10,12
Total Hours of instruction		**46**	

4.0 Course Content

Sl. No.	LIST OF EXPERIMENTS
1	Experiment to draw the speed torque characteristics of (i) AC servo motor (ii) DC servo motor
2	Experiment to draw synchro pair characteristics
3	Experiment to determine frequency response of a second order system
4	(a) To design a passive RC lead compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response.
5	(a) To design a passive RC lag compensating network for the given specifications, viz, the maximum phase lag and the frequency at which it occurs and to obtain the frequency response. (b) To determine experimentally the transfer function of the lag compensating network
6	Experiment to draw the frequency response characteristics of the lag – lead compensator network and determination of its transfer function.
7	To study a second order system and verify the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.
8	(a) To simulate a typical second order system and determine step response and evaluate time response specifications. (b)To evaluate the effect of adding poles and zeros on time response of second order system. (c) To evaluate the effect of pole location on stability.
9	(a) To simulate a D.C. Position control system and obtain its step response. (b) To verify the effect of input waveform, loop gain and system type on steady state errors. (c) To perform trade-off study for lead compensator. (d) To design PI controller and study its effect on steady state error.
10	(a) To examine the relationship between open-loop frequency response and stability, open-loop frequency and closed loop transient response. (b) To study the effect of open loop gain on transient response of closed loop system using root locus.

11	(a) To study the effect of open loop poles and zeros on root locus contour. (b) Comparative study of Bode, Nyquist and root locus with respect to stability.

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	VIII	Project work	System Control Applications

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Control system has a wide range of applications from the flight and propulsion systems of commercial airliners to the cruise control present in many modern automobiles. In most cases, control engineers utilize feedback while designing control systems. This is often accomplished using a PID controller system

7.0 Books Used and Recommended to Students

Text Books
1. Control Systems by Anand Kumar.
Reference Books
1. Automatic Control Systems by FaridGolnaraghi, Benjamin C. Kuo, Wiley , 9th Edition, 2010. 2. Control Systems Engineering by Norman S. Nise, 4th Edition, 2004. 3. Modern Control Systems by Richard C Dorf et al, Pearson, 11th Edition, 2008. 4. Control Systems, Principles and Design by M.Gopal ,McGaw Hill, 4th Edition, 2012. 5. Control Systems Engineering by S. Salivahanan et al, Pearson, 1st Edition, 2015.
Additional Study material & e-Books
1. Control Engineering by Ganesh Rao and Chennavenkatesh, Pearson.

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

Website and Internet Contents References
1) www.VSSUT.ac.in
2) https://nptel.ac.in/courses/107/106/107106081/
3) www.Smartzworld.com
4) www.Scribd.com

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	**IEEE Xplore: IEEE Control Systems Magazine**	www.ieeexplore.ieee.org

2	Journal of Control Theory and Applications, Journal of Real-Time Image Processing etc	www.Springer.com

10.0 Examination Note

Conduct of Practical Examination:

1. All Laboratory experiments are to be included for practical examination
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% marks allotted to the procedure part shall be made zero.

CIE Marks: 40

Theoretical aspects as well as relevant circuits should be drawn neatly for questions asked in Internal Assessments.

Scheme of Evaluation for Internal Assessment (40 Marks)

(a) Internal Assessment test in the same pattern as that of the main examination: 16 marks.

(b) Continuous Assessment: 24 marks

Scheme of Examination:

One question to be setfrom list of experiments for 16Marks
Write up- 03 marks
Conduction and Result- 10 marks
Viva Voce- 03 marks
Continuous assessment/ Journal Writing- 24 marks

Scheme of External examination:

External exam will be conducted for 100 marks and obtained marks will be scaled down for 60 marks by the university.

Question can appear on any of experiment.
Scheme of Evaluation for External Assessment (100 Marks)

Write up	15 Marks
Conduction& Result	70 Marks
Viva–Voce	15 Marks
Total	**100 Marks**

11.0 Course Delivery Plan

Expt No	Lecture / Pract No	Name of the Experiment	% of Portion
1	1	Experiment to draw the speed torque characteristics of (i) AC servo motor (ii) DC servo motor	8.33%
2	2	Experiment to draw synchro pair characteristics	8.33%
3	3	Experiment to determine frequency response of a second order system	8.33%

4	4	a)To design a passive RC lead compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response. (b) To determine experimentally the transfer function of the lead compensating network.	8.33%
5	5	(a)To design a passive RC lag compensating network for the given specifications, viz, the maximum phase lag and the frequency at which it occurs and to obtain the frequency response. (b) To determine experimentally the transfer function of the lag compensating network	8.33%
6	6	Experiment to draw the frequency response characteristics of the lag – lead compensator network and determination of its transfer function..	8.33%
7	7	(a) To simulate a typical second order system and determine step response and evaluate time response specifications. (b) To evaluate the effect of additional poles and zeros on time response of second order system. (c) To evaluate the effect of pole location on stability (d) To evaluate the effect of loop gain of a negative feedback system on stability.	8.33%
8	8	To simulate a second order system and study the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.	8.33%
9	9	(a) To simulate a D.C. Position control system and obtain its step response. (b) To verify the effect of input waveform, loop gain and system type on steady state errors. (c) To perform trade-off study for lead compensator. (d) To design PI controller and study its effect on steady state error.	8.33%
10	10	(a) To examine the relationship between open-loop frequency response and stability, open-loop frequency and closed loop transient response (b) To study the effect of open loop gain on transient response of closed loop system using root locus.	8.33%
11	11	(a) To study the effect of open loop poles and zeros on root locus contour (b) To estimate the effect of open loop gain on the transient response of closed loop system using root locus. (c) Comparative study of Bode, Nyquist and root locus with respect to stability.	8.33%

12.0 QUESTION BANK

1. What is control System?
2. What is open loop control system?
3. What is open loop control system?
4. Differentiate between open and closed loop control system.
5. What is lead compensating network?
6. What is lag compensating network?
7. What is lead- lag compensating network?
8. What is Servo motor?

9. What are the features does Servo Motors possess?
10. What is the difference between AC servomotor and two phase induction motors?
11. Compare AC servo motor and DC servo motors?
12. Some Applications where Servo motors are used?
13. What is Synchro?
14. What is Synchro pair?
15. What are the applications of Synchro pair?
16. What is Proportional Controller? Advantages and Disadvantages?
17. What is Integral Controller? Advantages and Disadvantages?
18. Why Derivative Controller is not used in isolation like Proportional and Integral?
19. For reducing Steady State error which type of controller is used?
20. Which type of controller anticipates the error?
21. What is order of the system?
22. What is Time response of the control system?
23. How Time response of the system is divided?
24. What are Test signals and their significance?
25. What is Pole of the system?
26. What is Zero of the system?
27. What is gain margin in bode plot?
28. Define phase margin in bode plot.

Prepared & Checked by		
24/03/23.	24.3.23	
Prof. Onkar. B. Heddurshetti	**HOD**	**Principal**

Subject Title	**DIGITAL SIGNAL PROCESSING LABORATORY**		
Subject Code	18EEL67	**CIE Marks**	40
No of Practical Hrs / Week	0:2:2	**SEE Marks**	60
RBT Levels	L1,L2,L3	**Exam Hours**	03
			CREDITS – 02

FACULTY DETAILS:		
Name: Prof. Amit U.Neshti	**Designation:** Asst. Professor	**Experience:** 14 Years
No. of times course taught: 03	**Specialization:** Digital Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	IV	Operation amplifiers and linear IC's
02	Electrical & Electronics Engineering	V	Signals and systems

2.0 Course Objectives

- To explain the use of MATLAB software in evaluating the DFT and IDFT of given sequence
- To verify the convolution property of the DFT
- To design and implementation of IIR and FIR filters for given frequency specifications.
- To realize IIR and FIR filters.
- To help the students in developing software skills

3.0 Course Outcomes

The student, after successful completion of the course, will be able to

CO	Course Outcome	Cognitive Level	Pos
C323.1	Explain physical interpretation of sampling theorem in time and frequency domains.	L1,L2,L3	1,2,8,9,10,12
C323.2	Evaluate the impulse response of a system.	L1,L2,L3	1,2,8,9,10,12
C323.3	Perform convolution of given sequences to evaluate the response of a system	L1,L2,L3	1,2,8,9,10,12
C323.4	Compute DFT and IDFT of a given sequence using the basic definition and/or fast methods.	L1,L2,L3	1,2,8,9,10,12
C323.5	Develop solution for a given difference equation.	L1,L2,L3	1,2,8,9,10,12
C323.6	Design and implement IIR and FIR filters	L1,L2,L3	1,2,8,9,10,12
Total Hours of instruction		**42**	

4.0 Course Content

Experiments

1. Verification of Sampling Theorem both in time and frequency domains
2. Evaluation of impulse response of a system
3. To perform linear convolution of given sequences
4. To perform circular convolution of given sequences using (a) the convolution summation formula (b) the matrix method and (c) Linear convolution from circular convolution with zero padding.
5. Computation of N – point DFT and to plot the magnitude and phase spectrum
6. Linear and circular convolution by DFT and IDFT method
7. Solution of a given difference equation.
8. Calculation of DFT and IDFT by FFT
9. Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject Filters)
10. Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using different window functions
11. Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using frequency sampling technique
12. Realization of IIR and FIR filters

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	VIII	Project work	Automation

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Digital photo camera, MP3 players to automobiles.
02	Speech processing, Image processing.
03	Application of audio processing.

7.0 Books Used and Recommended to Students

Text Books
1. Introduction to Digital Signal Processing, Johnny R. Johnson, Pearson, 1st Edition, 2016.
Reference Books
1. "Digital Signal Processing – Principles, Algorithms, and Applications, Jhon G. Proakis, Dimitris G. Manolakis Pearson 4th Edition, 2007. 2. Digital Signal Processing A.NagoorKani McGraw Hill, 2nd Edition, 2012. 3. Digital Signal Processing, Shaila D. Apte, Wiley ,2nd Edition, 2009, 4. Digital Signal Processing, Ashok Amberdar, Cengage, 1stEdition, 2007
Additional Study material & e-Books

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

Website and Internet Contents References
1. http://freevideolectures.com/Course/2339/Digital-Signal-Processing-IITKharagpur 2. https://www.youtube.com/playlist?list=PLaJppqXMef2ZHIKM4vpwHIAWyRmw3TtSf 3. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/

9.0 Magazines/Journals Used and Recommended to Students

SL.No	Magazines/Journals	Website
1	Elsevier Journal	https://www.journals.elsevier.com/digital-signal-processing/
2	ICGST Journal of Digital signal processing	http://www.icgst.com/journals/journal.aspx?subid=45
3	InternationalJournal of Advancements in Digital Signal Processing	http://journals.theired.org/ijdsp.html
4	Science Direct	http://www.sciencedirect.com/science/journal/10512004

10.0 Examination Note

Conduct of Practical Examination:

1. All Laboratory experiments are to be included for practical examination
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% marks allotted to the procedure part shall be made zero.

CIE Marks: 40

Theoretical aspects as well as relevant circuits should be drawn neatly for questions asked in Internal Assessments.

Scheme of Evaluation for Internal Assessment (40 Marks)

(a) Internal Assessment test in the same pattern as that of the main examination: 16 marks.

(b) Continuous Assessment: 24 marks

Scheme of Examination:

One question to be set from list of experiments for 16 Marks

Write up- 03 marks

Conduction and Result- 10 marks

Viva Voce- 03 marks

Continuous assessment/ Journal Writing- 24 marks

Scheme of External examination:

External exam will be conducted for 100 marks and obtained marks will be scaled down for 60 marks by the University.

Question can appear on any of experiment.

Scheme of Evaluation for External Assessment (100 Marks)

Write up	15 Marks
Conduction& Result	70 Marks
Viva – Voce	15 Marks
Total	**100 Marks**

11.0 Course Delivery Plan

Expt No	Lecture / Pract. No	Name of the Experiment	% Of Portion
1	1	Verification of Sampling Theorem both in time and frequency domains.	8.33%
2	2	Evaluation of impulse response of a system.	8.33%
3	3	To perform linear convolution of given sequences.	8.33%
4	4	To perform circular convolution of given sequences using (a) the convolution summation formula (b) the matrix method and (c) Linear convolution from circular convolution with zero padding.	8.33%
5	5	Computation of N – point DFT and to plot the magnitude and phase spectrum.	8.33%
6	6	Linear and circular convolution by DFT and IDFT method.	8.33%
7	7	Solution of a given difference equation.	8.33%
8	8	Calculation of DFT and IDFT by FFT	8.33%
9	9	Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject Filters)	8.33%
10	10	Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using different window functions	8.33%
11	11	Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using frequency sampling technique.	8.33%
12	12	Realization of IIR and FIR filters.	8.33%

12.0 QUESTION BANK

1. What is MATLAB?
2. What are the applications of MATLAB?
3. State sampling theorem.
4. What is meant by Nyquist rate and Nyquist criteria?
5. Explain scaling and superposition properties of a system.
6. What is meant by linearity of a system and how it is related to scaling and superposition?
7. What is impulse function?
8. What is meant by impulse response?
9. What is energy signal? How to calculate energy of a signal?
10. What is power signal? How to calculate power of a signal?
11. Differentiate between even and odd signals.

12. Explain time invariance property of a system with an example.
13. What is memory less system?
14. When a system is said to have memory?
15. What is meant by causality?
16. When a system is said to have memory?
17. What is meant by causality?
18. Explain linear convolution and circular convolution.
19. What is the length of linear and circular convolutions if the two sequences are having the length n1 and n2?
20. What are Fourier series and Fourier transform?
21. What are the advantages and special applications of Fourier transform, Fourier series, Z transform and Laplace transform?
22. Differentiate between DTFT and DFT. Why it is advantageous to use DFT in computers rather than DTFT?
23. What is cross-correlation?
24. What are the advantages of using autocorrelation and cross correlation properties in signal processing fields?
25. How auto-correlation can be used to detect the presence of noise?
26. Differentiate between IIR filters and FIR filters.
27. What is the procedure to design a digital Butterworth filter?
28. What is the difference between Butterworth, Chebyshev I and Chebyshev II filters?
29. What are difference equations and differential equations?
30. What is non real time processing?
31. What is a Digital Signal Processor (DSP)?
32. What is meant by real time processing?

Prepared by	Checked by		
			
Prof. Amit U.Neshti	**Prof. Mahesh Yenagimath**	**HOD**	**Principal**