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 III-SEM

S N	TOPIC	PAGE NO
1	Vision, Mission, PEO's, PO's and PSOs	I
2	Student Help Desk	III
3	Departmental Resources	IV
4	Teaching Faculty Details	V
5	Institute Academic Calendar	VI
6	Department Academic Calendar	VII
7	Scheme of Teaching & Examination V- Semester	VIII
	Course Plans , Question Bank & Assignment Questions	
	Theory	
	21MAT31-Transform Calculus, Fourier Series and Numerical Technics	
	21EE32-Analog Electronic Circuits And Op - Amps	
	21EE33-Electric Circuit Analysis	
	21EE34-Transformers and Generators	
	Practical	
	21EE35-Electrical Machines Laboratory - I	
	21EEL383- 555 IC Laboratory	

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	3rd Semester	Prof. A. U. Neshti	Shri. S. B. Beelur
16	5th Semester	Prof. O. B. Heddurshetti	Shri. V. M. Mutalik
17	7th 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	8	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. Yanagimath	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

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

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CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2022-23 (Odd)

Date	Events
19-09-2022	Commencement of Classes for VII Semester
24-09-2022	NSS Foundation Day
02-10-2022	Gandhi Jayanthi
10-10-2022	Commencement of Classes for V Semester
24-10-2022 to 30-10-2022	Traffic Week
27-10-2022 to 29-10-2022	First Internal Assessment for VII Semester
31-10-2022	Feedback -I on Teaching-Learning for VII Semester
31-10-2022	National Integration Day
31-10-2022	Commencement of Classes for III Semester
01-11-2022	Kannad Rajyothsava
03-11-2022	Display of 1st Internal Assessment Marks and submission of Feedback-I of VII Semester to office
09-11-2022 to 18-11-2022	Environment Awareness Month
22-11-2022	World's Aids Day
26-11-2022	First Assignment Submission of III Semester (PCC + IPCC)
28-11-2022 to 30-11-2022	Second Internal Assessment for VII Semester & First Internal Assessment for III (PCC + IPCC) /V Semester
01-12-2022	Feedback –II on Teaching-Learning for VII Semester & Feedback – I on Teaching-Learning for III/V Semester
06-12-2022	Display of 2nd Internal Assessment Marks and submission of Feedback-II of VII Semester & Display of 1st Internal Assessment Marks and submission of Feedback-I of III/V Semester to office
10-12-2022	Human Rights Day
10-12-2022	Sports Day
23-12-2022 & 24-12-2022	First Lab Internal Assessment for III Semester (PCC+AEC)
26-12-2022 & 27-12-2022	Lab Internal Assessment for VII Semester
29-12-2022 to 31-12-2022	Third Internal Assessment for VII Semester & Second Internal Assessment for III (PCC + IPCC) /V Semester
31-12-2022	Last working day for VII Semester
02-01-2023	Feedback –II on Teaching-Learning for III/V Semester
05-01-2023	Display of Final IA Marks of VII Semester
05-01-2023	Display of 2nd Internal Assessment Marks and submission of Feedback-II of III/V Semester to office
07-01-2023	Second Assignment Submission of III Semester (PCC + IPCC)
12-01-2023	National Youth Day
15-01-2023	NSS Day
20-01-2023 & 21-01-2023	Lab Internal Assessment for V Semester
23-01-2023 to 25-01-2023	Third Internal Assessment for V Semester
26-01-2023	Republic Day
27-01-2023	Last working day for V Semester
30-01-2023 to 01-02-2023	Second Lab Internal Assessment for III Semester (PCC+IPCC+AEC)
31-01-2023	Display of Final IA Marks of V Semester
06-02-2023 to 08-02-2023	Third Internal Assessment for III Semester (PCC)
11-02-2023	Last working day for III Semester
14-02-2023	Display of Final IA Marks of III Semester

September-2022

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October-2022

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04- Mahanavami, Ayudhapooja 05- Vijayadashami
24- Naraka Chaturdashi, 26- Balipadyami Deepavalli

Novemner-2022

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27	28	29	30			

01- Kannada Rajyothsava, 11- Kanakadasa Jayanti

December-2022

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January-2023

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29	30	31				

14-Makara Sankranti, 26- Republic Day

February-2023

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18- Mahashivaratri

19/9/22
Dr. B. V. Madiggond
Dean (Academics)

19/9
Dr. S. C. Kamate
Principal

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

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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGG.

CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2022-23 (Odd)

Date	Events
19-09-2022	Commencement of Classes for VII Semester
24-09-2022	NSS Foundation Day
01-10-2022	*Awareness Program on "How to carryout Literature Survey"*
02-10-2022	Gandhi Jayanthi
10-10-2022	Commencement of Classes for V Semester
24-10-2022 to 30-10-2022	Traffic Week
27-10-2022 to 29-10-2022	First Internal Assessment for VII Semester
31-10-2022	Feedback -I on Teaching-Learning for VII Semester
31-10-2022	National Integration Day
31-10-2022	Commencement of Classes for III Semester
01-11-2022	Kannad Rajyothsava
03-11-2022	Display of 1st Internal Assessment Marks and submission of Feedback-I of VII Semester to office
04-11-2022	*Inauguration of EESSA Activities for the AY 2022-23 & Welcome function to 3rd Sem Students*
09-11-2022 to 18-11-2022	Environment Awareness Month
12-11-2022	*Awareness Program on "PPT Preparation, Presentation and E-mail Etiquette"*
18-11-2022	*MOCK Press Event*
22-11-2022	World's Aids Day
26-11-2022	First Assignment Submission of III Semester (PCC + IPCC)
28-11-2022 to 30-11-2022	Second Internal Assessment for VII Semester & First Internal Assessment for III (PCC + IPCC) /V Semester
01-12-2022	Feedback –II on Teaching-Learning for VII Semester & Feedback – I on Teaching-Learning for III/V Semester
02-12-2022	*Seminar/ Guest lecture by Alumni/Resource person from industry*
05-12-2022 to 09-12-2022	*Five days workshop on "Python Programming for Electrical Engineers"*
06-12-2022	Display of 2nd Internal Assessment Marks and submission of Feedback-II of VII Semester & Display of 1st Internal Assessment Marks and submission of Feedback-I of III/V Semester to office
10-12-2022	Human Rights Day
10-12-2022	Sports Day
16-12-2022	*'Pick & Speak' Competition*
23-12-2022 & 24-12-2022	First Lab Internal Assessment for III Semester (PCC+AEC)
26-12-2022 & 27-12-2022	Lab Internal Assessment for VII Semester
29-12-2022 to 31-12-2022	Third Internal Assessment for VII Semester & Second Internal Assessment for III (PCC + IPCC) /V Semester
31-12-2022	Last working day for VII Semester
02-01-2023	Feedback –II on Teaching-Learning for III/V Semester
05-01-2023	Display of Final IA Marks of VII Semester
05-01-2023	Display of 2nd Internal Assessment Marks and submission of Feedback-II of III/V Semester to office
06-01-2023	*Industrial Visit to III & V Sem students*
07-01-2023	Second Assignment Submission of III Semester (PCC + IPCC)
12-01-2023	National Youth Day
15-01-2023	NSS Day
20-01-2023 & 21-01-2023	Lab Internal Assessment for V Semester
23-01-2023 to 25-01-2023	Third Internal Assessment for V Semester
26-01-2023	Republic Day
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30-01-2023 to 01-02-2023	Second Lab Internal Assessment for III Semester (PCC+IPCC+AEC)
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06-02-2023 to 08-02-2023	Third Internal Assessment for III Semester (PCC)
11-02-2023	Last working day for III Semester
14-02-2023	Display of Final IA Marks of III Semester

September-2022

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October-2022

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23	24	25	26	27	28	29
30	31					

04- Mahanavami, Ayudhapooja 05- Vijayadashami
24- Naraka Chaturdashi,
26- Balipadyami Deepavalli

Novemner-2022

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20	21	22	23	24	25	26
27	28	29	30			

01- Kannada Rajyothsava, 11- Kanakadasa Jayanti

December-2022

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January-2023

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22	23	24	25	26	27	28
29	30	31				

14-Makara Sankranti, 26- Republic Day

February-2023

S	M	T	W	T	F	S
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

18- Mahashivaratri

Shri. M. P. Yenagimath	Dr. B. V. Madiggond	Dr. S. C. Kamate
EESSA Coordinator	**HOD**	**Principal**

5.1 Scheme of Teaching & Examination

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations 2021
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

III SEMESTER

Sl No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Technics	Maths	2	2	0		03	50	50	100	3
2	IPCC 21EE32	Analog Electronic Circuits and Op - Amps	TD: PSB	3	0	2		03	50	50	100	4
3	IPCC 21EE33	Electric Circuit Analysis	TD: PSB	3	0	2		03	50	50	100	4
4	PCC 21EE34	Transformers and Generators	TD: PSB	2	2	0		03	50	50	100	3
5	PCC 21EEL35	Electrical Machines Laboratory - I	TD: PSB	0	0	2		03	50	50	100	1
6	UHV 21UH36/49	Social Connect and Responsibility	Any Department	0	2	0		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	0	2	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21EE38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as theory course: 0	2	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE) (Sports and Athletics), and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE)(Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T** – Tutorial, P- Practical/ Drawing, **S** – Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.
TD- Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

21INT49 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

A. Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

B. National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University. (3)In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III

21EEL381	Scilab for Transformers and Generators	21EEL383	555 IC Laboratory
21EEL382	Circuit laboratory using Pspice	21EEL384	Scilab for Mathematics

Course	Transform Calculus, Fourier Series and Numerical Techniques		
Course Code	21MAT31	**IA Marks**	50
Number of Lecture Hrs / Week	04	**Exam Marks**	50
Total Number of Lecture Hrs	40	**Exam Hours**	03
		CREDITS – 03	

FACULTY DETAILS:		
Name: Prof. S. S. Thabaj	Designation: Asst. Professor	Experience: 10
No. of times course taught: 01	**Specialization:** Mathematics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical and Electronics Engineering	II	Advanced Calculus & Numerical Methods

2.0 Course Objectives

Course Learning Objectives:

- To have an insight into solving ordinary differential equations by using Laplace transform techniques
- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.
- To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the z transform method.
- To develop proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods

3.0 Course Outcomes

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

Course Code	Course Outcome	RBTL	POs
C201.1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.	L1,L2,L3	1,2,3,12
C201.2	Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.	L1,L2,L3	1,2,3,12
C201.3	To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations	L1,L2,L3	1,2,3,12
C201.4	To solve mathematical models represented by initial or boundary value problems involving partial differential equations	L1,L2,L3	1,2,3,12
C201.5	Determine the externals of functional using calculus of variations and solve problems arising in dynamics of rigid bodies and vibration analysis.	L1,L2,L3	1,2,3,12
Total Hours of instruction		**40**	

4.0 Course Content

Module-1: Laplace Transform:

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace's Transform of $e^{at}f(t), t^n f(t), \frac{f(t)}{t}$. Laplace transforms of Periodic functions (statement only) and unit-step function – problems. Inverse Laplace Transform: Definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Laplace transforms of derivatives, solution of differential equations.
Self-study: Solution of simultaneous first-order differential equations. **(8 Hours)**

Module -2: Fourier Series:

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.
Self-study: Convergence of series by D'Alembert's Ratio test and, Cauchy's root test. **(8 Hours)**

Module -3: Infinite Fourier Transforms and Z-Transforms

Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems. Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations. **(8 Hours)**
Self Study: Initial value and final value theorems, problems.

Module -4: Numerical Solution of Partial Differential Equations

Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems. **(8 Hours)**
Self Study: Solution of Poisson equations using standard five-point formula.

Module -5: Numerical Solution of Second-Order ODEs and Calculus of Variations

Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae). Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems. **(8 Hours)**
Self Study: Hanging chain problem

5.0 Relevance to future subjects

Sl. No.	Semester	Subject	Topics
01	Common to all	Common to all engineering Subjects	Circuit Analysis, Field Theory, control Engg , signal analysis, Fluid Dynamics Thermodynamics, etc

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	Numerical methods are used to solve engineering problems. For examples will be drawn from a variety of engineering problems, including heat transfer, vibrations, dynamics, fluid mechanics, etc.
02	Laplace transform are used in various areas of physics, electrical engineering, control engineering, optics, mathematics and signal processing. Laplace Transform is widely used by electronic engineers to solve quickly differential equations occurring in the analysis of electronic circuits
03	Fourier series is that very little information is lost from the signal during the transformation. The Fourier transform maintains information on amplitude, harmonics, and phase and uses all parts of the waveform to translate the signal into the frequency domain.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Calculus of Variations

8.0 Books Used and Recommended to Students

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition 2018, Khanna Publishers.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2016.
3. Srimanta Pal et al Engineering Mathematics, 3rd Edition, 2016, Oxford University Press.

Reference Books

1. V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press,3rd Reprint, 2016.
3. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co. New York, Latest ed.
5. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", McGraw Hill Education (India) Pvt. Ltd 2015.
6. H. K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S. Chand Publication (2014).
7. James Stewart: "Calculus" Cengage publications,7th edition, 4th Reprint 2019.

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

Website and Internet Contents References

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU Edusat Programme
5. VTU e-Shikshana Program
6. http://www.bookstreet.in.

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	+ Plus Magazine	https://plus.maths.org/issue44.
2	Mathematics Magazine	www.mathematicsmagazine.com

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weight age of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks** (duration 01 hour)
2. First test at the end of 5th week of the semester
3. Second test at the end of the 10th week of the semester
4. Third test at the end of the 15th week of the semester.

Two assignments each of 10 Marks

5. First assignment at the end of 4th week of the semester
6. Second assignment at the end of 9th week of the semester
7. Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**
8. At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks** (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject **(duration 03 hours)**

- The question paper will be set for 100 marks and marks scored will be proportionally scaled down to 50 marks
- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecturer	% of Portion
1	1	Definition, transforms of elementary functions & Properties	
	2	Problems	
	3	Periodic function	
	4	Unit step function & Problems	
	5	Inverse Laplace Transforms	20

	6	Convolution theorem	
	7	Solution of linear differential equations using Laplace Transforms	
	8	Problems	
2	9	Introduction to infinite series	20
	10	convergence and divergence	
	11	Introduction, Periodic functions, Dirichlet's conditions	
	12	Fourier series of periodic functions of period 2π & Problems	
	13	Fourier series of periodic functions of arbitrary period 2l & Problems	
	14	Fourier series of even & odd functions	
	15	Half range Fourier series & Problems	
	16	Practical harmonic analysis	
3	17	Introduction, Infinite Fourier transform	20
	18	Fourier sine transforms & Problems	
	19	Fourier cosine transforms & Problems	
	20	Inverse Fourier transforms & Problems	
	21	z-transform-definition & Standard z-transforms	
	22	Initial value and final value theorems (without proof) and problems	
	23	Inverse z-transform & Problems	
	24	Applications of z-transforms to solve difference equations	
4	25	Classifications of second-order partial differential equations	20
	26	Finite difference approximations to derivatives	
	27	Solution of Laplace's equation using standard five-point formula.	
	28	Problems.	
	29	Solution of heat equation by Schmidt explicit formula	
	30	Solution of heat equation by Crank- Nicholson method	
	31	Solution of the Wave equation	
	32	Problems.	
5	33	Numerical solution of second order ordinary differential equations	20
	34	Runge -Kutta method & Problems.	
	35	Milne's method & Problems.	
	36	Problems.	
	37	Calculus of Variations: Variation of function & Functional, variation problems	
	38	Euler's equation	
	39	Problems	
	40	Geodesics and problems	

13.0 Assignments

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity.	Book 1, of the reference list. Website of the Reference list
2	Assignment 2: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 of the syllabus	4	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list
3	Assignment 3: University Questions	Students study the Topics and write the Answers. Get practice to solve university	Module 3 of the syllabus	6	Individual Activity.	Book 1, 2 of the reference list. Website of the

		questions.				Reference list
4	Assignment 4: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list
5	Assignment 5: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	10	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list

14.0 QUESTION BANK

Module-1: Laplace Transform

1. Find the Laplace Transform of $sin2t\ sin3t$. & $sin^3 2t$.
2. Find $L\ (e^3 tsin2t)$ & $L(e^{4t}\ sin2t\ cost)$.
3. Find $L\left(\frac{1-e^t}{t}\right)$ & $L[\frac{cosat\ -cosbt}{t}]$
4. Using unit step function find LT of $f(t) = \begin{cases} \sin t, & 0 < t < \pi \\ \sin 2t, & \pi < t < 2\pi \\ \sin 3t, & t > 2\pi \end{cases}$
5. Express $f(t) = \begin{cases} \cos t, & 0 < t < \pi \\ \cos 2t, & \pi < t < 2\pi \\ \cos 3t, & t > 2\pi \end{cases}$ in terms unit step function & hence find LT
6. Evaluate $L[t^2 u(t-3)]$.
7. Find the inverse transform $\frac{s+2}{s^2-4s+13}$.
8. Find $L^{-1}\left(\frac{4s+5}{(s-1)^2(x+2)}\right)$
9. Find $L^{-1}\left(\frac{s}{s^4+4a^4}\right)$.
10. Find $L^{-1}\left(\frac{s}{(s^2+a^2)^2}\right)$.
11. Find $L^{-1}\left[\ log\ \frac{(s+1)}{(s-1)}\right]$
12. Find $L^{-1}\left[\frac{s}{(2s-1)(3s-1)}\right]$
13. Using the Convolution THM obtain the $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$.
14. Solve the differential equation $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y\ =\ e^{3t}$ with $y(0) = 0 = y'(0)$, using LT
15. Solve the differential equation $y'' + 4y' + 3y = e^{-t}, y(0)\ = 1 =\ y'(0)$. Using LT

Module-2: Fourier series

1. Obtain a Fourier series to represent e^{-ax} from $(-\pi\ , x)$
2. Expand $f(x)\ =\ x\ sin\ x, 0\ <\ x\ <\ 2$, in a Fourier series.
3. For a function $f(x)$ defined by $f(x)\ =\ |x\ |,\ -\pi\ <\ x\ <\ \pi,$ obtain a Fourier series. Deduce that
   $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} = \frac{\pi^2}{8}$
4. Find the Fourier series for the function $f(x) = \frac{\pi - x}{2}$ in $(0, 2\pi)$.
   Hence deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - - -$
5. Find the Fourier series to represent $f(x)\ =\ x + x^2$ from $x = -\pi$ to $x =\ \pi$ and deduce that

$\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}=\frac{\pi^2}{12}$

6. Expand $f(x) = e^{-x}$ as a Fourier series in the interval $(-l, l)$
7. Obtain Fourier series for the function

$f(x)=\begin{cases}\pi x, & 0 \le x \le 1\\ \pi(2-x), & 1 \le x \le 2\end{cases}$ and deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}$-------

8. Develop f(x) in Fourier series in the interval (-2, 2) if $f(x)=\begin{cases}0, & -2 < x < 0\\ 1, & 0 < x < 2\end{cases}$
9. Find the half range cosine series for the function $f(x) = x^2$ in the range $0 \le x \le 1$
10. Find the complex form of the Fourier series of the periodic function$f(x) = cos\, ax$, in $-\pi < x < \pi$.
11. The following table gives the variation of periodic current over a period

t sec	0	T/6	T/3	T/2	2T/3	5T/6	T
A amp	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of the first harmonic.

12. Obtain the Fourier expansion of $f(x) = 2x - x^2$ in $0 \le x \le 2$
13. Obtain the constant term and the coefficient of the first sine and cosine terms in the Fourier expansion of y as given below.

x	0	1	2	3	4	5
y	9	18	24	28	26	20

Module-3: Infinite Fourier Transforms and Z-Transforms

1. Find the Fourier transform of

$f(x)=\begin{cases}1, & |x| < 1\\ 0, & |x| < 1\end{cases}$. Hence evaluate $\int_0^\infty \frac{sinx}{x}dx$

2. Find the Fourier transform of the function

$f(x)=\begin{cases}x, & |x| \le \\ 0, & |x| > \alpha\end{cases}$. Where α is a positive constant?

3. Find the Fourier transform of $cosax^2$
4. Find the Fourier sine transform of e^{-ax}/x
5. Find the Fourier sine and cosine transform of $f(x)=\begin{cases}1, & 0 \le x < a\\ 0, & x \ge a\end{cases}$
6. Find the finite Fourier sine and cosine transform of $f(x) = 2x, \quad 0 < x < 4$.
7. Find the cosine transform of $f(x)=\frac{1}{1+x^2}$
8. Find the Fourier sine transform of $e^{-|x|}$
9. Find the Fourier transform of $f(x)=\begin{cases}a^2-x^2, & |x| < a\\ 0, & |x| > a\end{cases}$ and Evaluate $\int_0^\infty \frac{sinx-xcosx}{x^3}dx$.
10. Find the Fourier sine transform of $f(x)=\frac{e^{-ax}}{x}$, $a > 0$.
11. Find the Fourier cosine transform of $(x)=\begin{cases}x, & 0 < x < 1\\ 2-x, & 1 < x < 2\\ 0, & x > 2\end{cases}$.
12. Find the Fourier transform of $f(x) = e^{-|x|}$ and Evaluate $\int_0^\infty \frac{xsinmx}{1+x^2}dx$.
13. Find the Fourier transform of $f(x) = e^{-|x|}$ and Evaluate $\int_0^\infty \frac{xsinmx}{1+x^2}dx$.

14. P.T. $z_T(n^2) = \frac{z^2+z}{(z-1)^3}$
15. P.T. $z_T(n^3) = \frac{z^3+4z^2+2}{(z-1)^4}$
16. P.T. $z_T(cos\theta) = \frac{z(z-cos\theta)}{z^2-2zcos\theta+1}$
17. P.T. $z_T(sin\theta) = \frac{(zsin\theta)}{z^2-2zcos\theta+1}$
18. P.T. $z_T(a^n cosn\theta) = \frac{z(z-acos\theta)}{z^2-2azcos\theta+a^2}$
19. Find the Z-transform of $cos\ hn\theta$ & $sinhn\theta$.
20. Find the Z-transform of $(n+1)^2$
21. Using the inversion integral method find the inverse Z-transform of $\frac{3z}{(z-1)(z-2)}$
22. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_n = 0$ using Z-transform
23. Solve the difference equation $y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = y_n = 0$ using Z-Transform.
24. Obtain the z-transform of $cos\ n\theta$ and $sin\ n\theta$
25. Find the Inverse z-transform of $\frac{2z^2+3z}{(z+2)(z-4)}$.
26. If $\bar{u}(z) = \frac{2z^2+3z+12}{(z-1)^4}$, find the value of $u_0,\ u_1,\ u_2,\ u_3$.
27. Solve the difference equation $u_{n+2} + 6u_{n+1} + 9u_n = 2^n$, $u_0 = u_1 = 0$.

Module -4: Numerical Solution of Partial Differential Equations

1. Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ in $0 < x < 5,\ t \geq 0$ given that $u(x,0) = 20, u(0,t) = 0, u(5,t) = 100$.Compute u for thetime step with $h = 1$ by Crank Nicholson method.
2. Find the solution of the parabolic equation $u_{xx} = 2u_t$ when $u(0,t) = 0 = u(4,t) = 0$ and $u(x,0) = x(4-x)$, taking $h = 1$. Find the values up to $t = 5$.
3. Solve the equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$ with the conditions $u(0,t) = 0, u(x,0) = x(1-x)$ and $u(1,t) = 0$. Assume $h = 0.1$. Tabulate u for $t = k, 2k$ and $3k$ choosing an appropriate value of k.
4. Solve the boundary value problem $u_{tt} = u_{xx}$ with the conditions $u(0,t) = u(1,t) = 0$, $u(x,0) = \frac{1}{2}x(1-x)$ and $u_t(x,0) = 0$, taking $h = k = 0.1$ for $0 \leq t \leq 0.4$. Compare your solution with the exact solution at $x = 0.5$ and $t = 0.3$.
5. Solve $y_{tt} = y_{xx}$ upto $t = 0.5$ with a spacing of 0.1 subject to $y(0,t) = 0, y(1,t) = 0, y_t(x,0) = 0$ and $y(x,0) = 10 + x(1-x)$.Solve the equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in Fig. Iterate until the maximum difference between the successive values at any point is less than 0.001.

Module -5: Numerical Methods and Calculus of Variation

1. Use R- K method to solve $y = xy'^2 - y^2$ for x = 0.2 correct to 4 decimal places. $y(0) = 1$ & $y'(0) = 0$
2. Evaluate $y(0.2)$ by RK method given that $y'' - x(y')^2 + y^2 = 0, y(0) = 1,\ y'(0) = 0$
3. Given $y'' - xy' - y = 0$ with the initial conditions y(0)=1, y'(0)=0. Compute y(0.2) and y'(0.2) by taking h=0.2 and using fourth order Runge Kutta method.

4. Obtain the solution of the equation $2\frac{d^2y}{dx^2} = 4x + \frac{dy}{dx}$ at the point $x = 1.4$ by applying Milne's method given that $y(1) = 2,\ y(1.1) = 2.2156,\ y(1.2) = 2.4649.\ y(1.3) = 2.7514, y'(1) = 2, y'(1.1) = 2.3178, y'(1.2) = 2.6725\ and\ y'(1.3) = 3.0657.$
5. Using R-K method of order four, solve $y'' = y + xy'$, y(0) = 1 , y'(0) to find $y(0.2)$ & $y'(0.2)$.
6. Show that the Geodesics on a plane are straight line.
7. Find the Geodesics on a right circular cylinder of radius a.
8. Find the extremals of the functional $\int_{x_0}^{x_1} \frac{(y')^2}{x^3} dx$
9. Show that the shortest distance between any two points in a plane is a straight line.
10. Prove that Catenaries' is the curve which when rotated about a line generates a surface of minimum area.
11. Find the extremely of the functional $\int_0^{\pi}(y'^2 - y^2 + 4ycosx)dx;\ y(0) = 0 = y(\pi)$
12. Solve the variation problem $\delta\int_1^2(x^2(y')^2 + 2y(x+y))dx = 0, given\ y(1) = y(2) = 0$
13. Find the path on which a particle in the absence of friction will slide from one point to another in a shortest time under the action of gravity.
14. Find the curve passing through the point (x_1, y_1) and (x_2, y_2) which when rotated about the x axis gives the minimum surface area.
15. Find the curve on which the functional $\int_0^1(y'^2 + 12xy)\,dx$ with $y(0) = 0$ and $y(1) = 1$ can be extremised.

16.0 University Result

Prepared by	Checked by		
			
Prof.S.S.Thabaj	Dr. S. L. Patil	**HOD**	**Principal**

Subject Title	**ANALOG ELECTRONIC CIRCUITS AND OP - AMPS**		
Subject Code	21EE32	**CIE Marks**	50
Number of Lecture Hrs / Week (L:T:P)	3:1:4	**SEE Marks**	50
Total Number of Lecture Hrs	40 hours Theory + 12 Lab	**Exam Hours**	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Shri. Shivanand Hirekodi	**Designation:** Asst. Professor	**Experience:**22
No. of times course taught:01	**Specialization:** Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	First year Engineering	I/II	Basic Electrical Engg.
02	First year Engineering	I/II	Basic Electronics.

2.0 Course Objectives

1. Provide the knowledge for the analysis of diode and transistor circuits.
2. Develop skills to design the electronic circuits using transistors and Op-amps.
3. To understand the concept of various types of electronic circuits such as amplifier, oscillator, filters, voltage regulators and converters.

3.0 Course Outcomes

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

	Course Outcome	Cognitive Level	POs
C202.1	Obtain characteristics of clipper and clamper circuits, design voltage divider biasing circuits and analyze transistor circuit using h- parameter.	L_1,L_4	1,2,3,6,8,9,10,12
C202.2	Design and analyze multistage amplifiers and feedback circuits.	L_1-L_4	1,2,3,6,8,9,10,12
C202.3	Design and analyze different power amplifier circuits and explain the construction, working and characteristics of JFET and MOSFET.	L_1-L_4	1,2,3,6,8,9,10,12
C202.4	Explain concepts of Op-amp, active filters and DC voltage regulators.	L_1-L_4	1,2,3,6,8,9,10,12
C202.5	Demonstrate the application of Op-amps.	L_1-L_4	1,2,3,6,8,9,10,12
Total Hours of instruction		**40**	

4.0 Course Content

MODULE – 1

Diode Circuits: Diode characteristics, Diode clipping and clamping circuits.
Transistor at Low Frequencies: Operating point, voltage divider bias circuit, stability factor, BJT transistor modelling- emitter follower, analysis using h – parameter model.

MODULE – 2

Multistage Amplifiers: Transistor Amplifiers, Cascade and cascode connections, Darlington circuits, analysis and design.
Feedback Amplifiers: Feedback concept, different types, practical feedback circuits, analysis and design of feedback circuits.

MODULE - 3

Power Amplifiers: Classification, analysis and design of Class A – Directly Coupled and Transformer Coupled,Class B- Complementry Symmetry and Push Pull, Class C and Class AB.
FETs: Construction, working and characteristics of JFETs and MOSFETs.

MODULE – 4

Op-Amp Applications: A.C. amplifier, summing, scaling & averaging amplifier, inverting and non-inverting configuration, Instrumentation amplifier.
Active Filters: First & Second order high pass & low pass Butterworth filters. Band pass filters, all pass filters.
DC Voltage Regulators: Voltage regulator basics, voltage follower regulator, adjustable output regulator, LM317 & LM337 Integrated circuits regulators.

MODULE – 5

OP –Amp Signal Generators: Integrator and Differentiator circuits, Triangular / rectangular wave generator, phase shift oscillator, saw tooth generator.
OP –Amp Comparators and Converters: Basic comparator, zero crossing detector, inverting & non-invertingSchmitt trigger circuit, voltage to current converter with grounded load, current to voltage converter and basics of voltage to frequency and frequency to voltage converters.

Sl. NO	Experiments
1	Experiments on clippers and clampers.
2	Static Transistor characteristics for CE, CB and CC modes and determination of h parameters.
3	Frequency response of single stage BJT and FET RC coupled amplifier and determination of half - power points, bandwidth, input and output impedances.
4	Design and testing of BJT -RC phase shift oscillator for given frequency of oscillation.
5	Determination of gain, input and output impedance of BJT Darlington emitter follower with and without bootstrapping.
6	Design and verify a precision full wave rectifier. Determine the performance parameters.
7	Design and realize to analyse the frequency response of an op – amp amplifier under inverting and non - inverting configuration for a given gain.
8	Design and verify the output waveform of an op – amp RC phase shift oscillator for a desired frequency.
9	Design and realize Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) and lowertrip point (LTP).
10	Verify the operation of an op – amp as (a) voltage comparator circuit and (b) zero crossing detector.
11	Design and verify the operation of op – amp as an (a) adder (b) subtractor (c) integrator and (d) differentiator.
12	Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass and (c) band pass filters for a given cut off frequency/frequencies to verify the frequency response characteristic.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	V	Power Electronics	Design of converters
02	VII	Project work	Design of power supplies, amplifiers and oscillators.

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Design of clippers, clampers, rectifiers, amplifiers, oscillators, voltage regulators, filters for various applications in analog electronics domains.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Lab visit	To gain practical knowledge about analog electronics circuits and Op-amps.
02	Industry /Field visit	To study design and manufacturing process of electronic based gadgets, appliances etc.

8.0 Books Used and Recommended to Students

Text Books: Suggested Learning Resources
1. Electronic Devices and Circuit Theory by Robert L Boylestad Louis Nashelsky, Pearson, 11th Edition, 2015.
2. Electronic Devices and Circuits by David A Bell, Oxford University Press,5th Edition.
3. Op-Amps and Linear Integrated Circuits by Ramakant A Gayakwad, Pearson, 4thEdition.
4. Operational Amplifiers and Linear ICs by David A. Bell, Oxford, 3rd Edition 2011.
Additional Learning Resources
1. Analog Electronic Circuits- a simplified Approach by U.B. Mahadevaswamy Sanguine Technical Publication.

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

Website and Internet Contents References
https://en.wikipedia.org/wiki/transistor amplifier https://www.electronicsforu.com https://www.electronics-tutorials.ws/opamp/opamp_1.html

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	AEÜ - International Journal of Electronics and Communications	https://www.scimagojr.com/journalsearch.php?q=17683&tip=sid
2	International Journal of Electronics and Communications	https://www.sciencedirect.com/journal/aeu-international-journal-of-electronics-and-communications

11.0 Examination Note

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together

CIE for the theory component of IPCC

- Two Tests each of 20 Marks (duration 01 hour)
- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Two assignments each of 10 Marks
- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester
- Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for 30 marks.

CIE for the practical component of IPCC

- On completion of every experiment in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (duration 03 hours) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

SEE for IPCC

- Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)
- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.
- Questions mentioned in the SEE paper shall include questions from the practical component.
- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

12.0 Course Delivery Plan

Unit No.	Lecture No.	Content of Lecture	% Portion
1	1.	**Diode Circuits:** Diode characteristics	20
	2.	Diode clipping circuits	
	3.	Diode clamping circuits	
	4.	**Transistor at Low Frequencies:** Operating point	
	5.	voltage divider bias circuit	
	6.	Stability factor	
	7.	BJT transistor modeling- emitter follower	20
	8.	Analysis using h – parameter model.	
2	9.	**Multistage Amplifiers:** Transistor Amplifiers	
	10.	Cascade connections	
	11.	Cascode connections	
	12.	Darlington circuits, analysisand design.	
	13.	**Feedback Amplifiers:** Feedback concept	
	14.	Feedback connection types	
	15.	Different types of practical feedback circuits	
	16.	Analysis and design of feedback circuits.	
3	17.	**Power Amplifiers:** Classification	20
	18.	Analysis and design of Class A – Directly Coupled amplifier.	
	19.	Analysis and design of Transformer Coupled amplifier.	
	20.	Class B- Complementary Symmetry amplifier.	
	21.	Push Pull amplifier	
	22.	Class C and Class AB amplifier	
	23.	**FETs:** Construction, working	
	24.	Characteristics of JFETs and MOSFETs.	
4	25.	**Op-Amp Applications:** A.C. amplifier, summing, scaling & averaging amplifier.	20
	26.	Inverting and non-inverting configuration.	
	27.	Instrumentation amplifier.	
	28.	**Active Filters:** First & Second order high pass & low pass Butterworth filters.	
	29.	Band pass filters, all pass filters.	
	30.	**DC Voltage Regulators:** Voltage regulator basics, voltage follower regulator.	
	31.	Adjustable output regulator	
	32.	LM317 & LM337 Integrated circuits regulators.	
5	33.	**OP –Amp Signal Generators:** Integrator and Differentiator circuits.	20
	34.	Triangular / rectangular wave generator.	
	35.	Phase shift oscillator.	
	36.	Saw tooth generator.	
	37.	**OP –Amp Comparators and Converters:** Basic comparator, zero crossing detector.	
	38.	Inverting & non-invertingSchmitt trigger circuit.	
	39.	Voltage to current converter with grounded load.	
	40.	Current to voltage converter and basics of voltage to frequency and frequency to voltage converters.	

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	Students study the topics on diode and transistor circuits, Multi stage and Power amplifiers and feedback circuits. Get practice to solve questions.	Module 1 ,2 and 3 of the syllabus	4	Individual Activity.	Books 1-4 of Text Book list.
2	Assignment 2	Students study the topics on Op-amps, Active filters and Voltage regulators. Get practice to solve questions.	Module 3 and 4 of the syllabus	9	Individual Activity.	Books 1-4 of Text Book list.

14.0 QUESTION BANK

MODULE 1

1. Draw and explain the working of the clamper circuit which clamps the positive peak of a signal to zero volts.
2. Define clipping circuit. Mention a few applications.
3. How series clipper can be used to obtain i) Clipping above the reference voltage V_R
   ii) Clipping below the reference voltage V_R.
4. Draw and explain a double diode clipper circuit which limits the output at two independent levels.
5. With neat diagram and waveforms explain the working of a negative clamper.
6. Explain voltage divider bias with neat circuit diagram and necessary equatons.
7. With suitable graph, explain the significance of operating point.
8. Derive the expressions for stability factor for voltage divider circuit.
9. A voltage divider bias circuit has R_1 = 39Kohm, R_2 = 82 Kohm, Rc = 3.3Kohm, R_E = 1Kohm and V_{CC} = 18V. the silicon transistor used has β = 120. Find Q-point and stability factor.

MODULE 2

1. Using exact hybrid model of a C-E transistor amplifier, obtain the expressions for current gain, voltage gain, output resistance and input resistance.
2. State and explain Miller's theorem.
3. Obtain an expression in terms of h- parameters for a transistor as a two port network. Using the above developed equations obtain the hybrid model of CE,CC and CB configurations.
4. Derive an expression for voltage gain and current gain of an amplifier circuit using BJT in CE configuration using approximate hybrid model.
5. What are the advantages of h-parameters?
6. A transistor is connected as a common emitter amplifier driving a load of 10KΩ. It is supplied by a source of 1KΩ internal resistance. The h parameters are hie=1.1kΩ, hfe=50, hre=$2.5x10^{-4}$ and hoe=1/40KΩ.
7. Find i) Current gain iii)input impedance ii) Voltage gain iv)output impedance
   Using complete or exact hybrid model equivalent model of a transistor, obtain the expressions for current gain, voltage gain, output impedance and input impedance.

8. Discuss the factors that affect the low frequency response of a BJT-CE amplifier.
9. What are the advantages of negative feedback in an amplifier?
10. Explain positive feedback and negative feedback mentioning the merits and demerits of each.
11. Give the classification of multistage amplifier. Explain the various distortions in amplifiers.
12. Discuss the general characteristics of a negative feedback amplifier.
13. Explain the concept of 'feedback' in amplifiers.
14. Explain the working of any one type of feedback amplifier and list its characteristics.
15. Derive an expression for the input resistance with feedback amplifier employing voltage series feedback.
16. For voltage series feedback derive expressions for output impedance.

MODULE 3

1. How is power amplifiers classified? Discuss them briefly.
2. Bring out the salient features of class A, class b, class c and class AB operation
3. What are classifications of power amplifiers based on the location of Q-point? Indicate the operating cycle in each case.
4. Explain the working of series fed directly coupled class A amplifier, with the help of neat circuit diagram.
5. Prove that the maximum efficiency of a series fed directly coupled class a amplifier is just 25%.
6. Explain with neat circuit diagram, the working of a transformer coupled class A power amplifier.
7. Prove that a transformer coupled class A amplifier has maximum power efficiency of 50%.
8. Draw the circuit diagram of a class B push pull amplifier and explain the operation with relevant waveforms.
9. Show that the maximum conversion efficiency of the class B push pull amplifier is 78.5%.
10. Show that even harmonics are absent in the output of a push pull amplifier.
11. Explain the three point method of calculating the second harmonic distortion.
12. Explain the working of complementary symmetry class B amplifier.
13. Derive the condition for maximum power dissipation of a class B amplifier. State the expression for maximum power dissipation.
14. What is cross over distortion? Explain.
15. Give the output characteristic of JFET and mark the salient regions on the graph.
16. Write the comparison between depletion type MOSFET and enhancement type MOSFET.
17. With neat sketch, explain basic construction of depletion type MOSFET.
18. Draw and explain transfer and drain characteristics of n-channel depletion type MOSFET.

MODULE 4

1. Sketch an op-amp inverting amplifier circuit. Also sketch a basic op-amp circuit connected to function as an inverting amplifier. Derive an equation for its voltage gain.
2. An op-amp non-inverting amplifier has resistors of R2= 22KΩ, and R3= 120Ω, Calculate the output voltage produced by a 75mV input.
3. An op-amp inverting amplifier is to have a voltage gain of 150. If R2 is 33KΩ, determine a suitable resistance value of R1.
4. Write equations for input impedance, output impedance and voltage gain for an inverting amplifier.
5. Sketch an op-amp difference amplifier circuit. Explain the operation of the circuit and derive an equation for the output voltage.
6. Two signals which each range from 0.1 V to 1 V are to be summed. Using a 741 op-amp, design a suitable inverting summing circuit.
7. An inverting amplifier with a +/- 12 V supply is to produce maximum possible output voltage and is to have a voltage gain of 33. Using 741 op-amps, design a suitable circuit.
8. Draw an all pass phase lag circuit. Sketch the input and output waveforms and the typical frequency response, and explain the circuit operation.

9. Write the equation for the voltage gain of a first order low pass active filter, and briefly discuss the circuit design procedure.
10. Sketch the circuit of a second order active high-pass filter. Briefly explain its operation.
11. Design a first order active low pass filter circuit with a cutoff frequency of 3 kHz.
12. Design a second order high pass filter circuit to have a cutoff frequency of 7 kHz. Estimate the highest signal that can be passed.
13. Briefly explain the action of a dc voltage regulator. Write the equations for line regulation, load regulation and ripple rejection.
14. Briefly discuss the design procedure for a voltage follower regulator.
15. Sketch a regulator circuit using an LM317 IC voltage regulator. Explain the circuit operation, write the equation for output voltage, and discuss the required supply voltage.
16. With a neat sketch explain the operation of adjustable voltage regulator.

MODULE 5

1. Sketch the circuit of a triangular/ rectangular waveform generator. Draw the output waveforms from the circuit showing their phase relationship and explain the circuit operation.
2. Discuss the design procedure for a triangular/ rectangular waveform generator and write the equations for calculating the component values.
3. Sketch the circuit of a phase shift oscillator that uses diodes for output amplitude stabilization. Explain how the amplitude stabilization circuit operates and show how a distortion control may be included.
4. Design a triangular/ rectangular waveform generator to have an output frequency of 1kHz, a triangular output amplitude of +/- 6 , and a square wave output amplitude of approximately +/ - 10 V.
5. Draw an op-amp inverting Schmitt trigger circuit. Sketch typical input output waveforms. Explain the circuit operation and the shape of the waveforms.
6. Discuss the design process for an op-amp inverting Schmitt trigger circuit, and write equations for calculating each component value.
7. Using op-amp with a +/- 15 V supply, design a non-inverting Schmitt trigger circuit to have UTP= 1V and LTP= -1.5 V

Prepared by	Checked by		
30/10/2022	30/10/2022	30/10/22	
Shri S. D. Hirekodi.	Shri. M. P. Yenagimath	HOD	Principal

Subject Title	**ELECTRIC CIRCUIT ANALYSIS**		
Subject Code	21EE33	**CIE Marks**	50
Number of Lecture Hrs / Week(L:T:P:S)	3:1:4:0	**SEE Marks**	50
Total Number of Lecture Hrs	40 hours Theory + 10 Lab slots	**Exam Hours**	03
Credits-04			

FACULTY DETAILS:		
Name: Prof. Amit U Neshti	**Designation:** Asst. Professor	**Experience:** 13 Years
No. of times course taught: 02	**Specialization:** Digital Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	First Year	I/II	Basic Electrical Engg.

2.0 Course Objectives

1. To familiarize the basic laws, source transformations theorems and the methods of analyzing electrical circuits.
2. To explain the use of network theorems and the concept of resonance.
3. To familiarize the analysis of three-phase circuits, two port networks and networks with non-sinusoidal inputs.
4. To explain the importance of initial conditions, their evaluation and transient analysis of R-L and R-C circuits.
5. To impart basic knowledge on network analysis using Laplace transforms.

3.0 Course Outcomes

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

	Course Outcome	**RBT Level**	**Pos**
C203.1	Apply the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network using source shifting, source transformation and network reduction using transformations.	L3	1,2,3,5,8,9,12
C203.2	Analyze complex electric circuits using network theorems.	L4	1,2,3,5,8,9,12
C203.3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.	L3	1,2,3,5,8,9,12
C203.4	Analyze typical waveforms using Laplace transformation.	L4	1,2,3,5,8,9,12
C203.5	Discuss unbalanced three phase systems and also evaluate the performance of two port networks.	L3	1,2,3,5,8,9,12
Total Hours		**40**	

4.0 Course Content

Module-1

Basic Concepts: Active and passive elements, Concept of ideal and practical sources. Source transformation and Source shifting, Concept of Super-Mesh and Super node analysis. Analysis of networks by (i) Network reduction method including star – delta transformation, (ii) Mesh and Node voltage methods for ac and dc circuits with independent and dependent sources. Duality.

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Module-2

Network Theorems: Super Position Theorem, Reciprocity theorem, Thevenin's Theorem, and Norton's Theorem Maximum power transfer theorem and Millman's theorem. Analysis of networks, with and without dependent ac and dc sources.

Module-3

Resonant Circuits:Analysis of simple series RLC and parallel RLC circuits under resonances. Problems on Resonant frequency, Bandwidth and Quality factor at resonance
Transient Analysis:Transient analysis of RL and RC circuits under dc and ac excitations: Behaviour of circuit elements under switching action (t=0 & t=∞), Evaluation of initial conditions. 10 Hours.

Module-4

Laplace Transformation: Laplace transformation (LT), LT of Impulse, Step, Ramp, Sinusoidal signals and shifted functions. Waveform synthesis. Initial and Final value theorems.

Module-5

Unbalanced Three phase systems: Analysis of three phase systems, calculation of real and reactive powers.
Two Port networks: Definition, Open circuit impedance, Short circuit admittance and Transmission parameters and their evaluation for simple circuits, relationships between parameter sets.

Sl. NO	Experiments
1	Loading effect of different voltmeters on an electric circuit.
2	Voltage Dividers with Loads
3	Measurement AC and DC quantities (voltage, frequency, current) using oscilloscope.
4	Determination of resonant frequency, bandwidth, and Q of a series circuit.
5	Determination of resonant frequency, bandwidth, and Q of a parallel circuit.
6	Verification of Thevenin's theorem.
7	Verification of Norton's theorem.
8	Verification of Superposition theorem.
9	Power factor correction.
10	Measurement of time constant of an RC circuit.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VI	Power system analysis and stability	Transmission line parameters

6.0 Relevance to Real World

Sl.No	Real World Mapping
01	Design and simplification of various networks to determine desired parameters in lead lag network, PID controllers, servo controllers etc.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Practical	Simulation of electric networks to determine magnitudes of currents & voltages through MATLAB.l.' software.

8.0 Books Used and Recommended to Students

Text Books
1.Engineering Circuit Analysis, William H Hayt et al, Mc Graw Hill, 8th Edition,2014 2.Network Analysis, M.E. Vanvalkenburg, Pearson, 3rd Edition,2014 3.Fundamentals of Electric Circuits, Charles K Alexander Matthew N O Sadiku, Mc Graw Hill, 5th Edition,2013
Reference Books
1. Engineering Circuit Analysis, J David Irwin et al, Wiley India, 10th Edition,2014 2.Electric Circuits Mahmood Nahvi Mc Graw Hill 5th Edition,2009 3.Introduction to Electric Circuits, Richard C Dorf and James A Svoboda, Wiley, 9th Edition,2015 4.Circuit Analysis; Theory and Practice, Allan H Robbins Wilhelm C Miller, Cengage, 5th Edition,2013
Additional Study material & e-Books
1. Network theory by Ganesh Rao
2. Network analysis by P M Chandrashekaraiah
3. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic

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

Website and Internet Contents References
1) http://nptel.ac.in/courses/108102042/ 2) http://nptel.ac.in/courses/108102042/# 3) http://videos.vtu.ac.in/video_groups.php?group=EDUSAT 2016 4) https://www.docsity.com/en/subjects/electrical-circuit-analysis/ 5) https://sites.google.com/site/eeenotes2u/courses/network-analysis

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	IEEE transactions on circuit thoery	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=8147
2	IRE Transactions on Circuit Theory	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=8148

11.0 Examination Note

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together

CIE for the theory component of IPCC

- Two Tests each of 20 Marks (duration 01 hour)
- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Two assignments each of 10 Marks
- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester
- Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for 30 marks.

CIE for the practical component of IPCC

- On completion of every experiment in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (duration 03 hours) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

SEE for IPCC

- Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)
- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only.
- Questions mentioned in the SEE paper shall include questions from the practical component.
- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to

qualify in the SEE. Marks secured will be scaled down to 50.

.12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecture	% of Portion
I	1.	**Basic Concepts:** Active and passive elements, Concept of ideal and practical sources.	20
	2.	Source transformation and Source shifting,	
	3.	Concept of Super-Mesh and Super node analysis.	
	4.	Analysis of networks by (i) Network reduction method including star – delta transformation.	
	5.	(ii) Mesh and Node voltage methods for ac and dc circuits with independent and dependent sources.	
	6.	Duality.	
	7.	Numerical	
	8.	Numerical	
II	9.	**Network Theorems:** Super Position Theorem	20
	10.	Reciprocity theorem	
	11.	Thevenin's Theorem	
	12.	Norton's Theorem.	
	13.	Analysis of networks, with and without dependent ac and dc sources.	
	14.	Numerical	
	15.	Numerical	
	16.	Numerical	
III	17.	**Resonant Circuits**: Analysis of simple series RLC circuits under resonances.	20
	18.	Analysis of simple parallel RLC circuits under resonances.	
	19.	Problems on Resonant frequency, Bandwidth and Quality factor at resonance	
	20.	**Transient Analysis**: Transient analysis of RL and RC circuits under dc and ac excitations:	
	21.	Behaviour of circuit elements under switching action.	
	22.	Evaluation of initial conditions.	
	23.	Numerical	
	24.	Numerical	
IV	25.	**Laplace Transformation:** Laplace transformation (LT), LT of Impulse function.	20
	26.	LT of Step, Ramp functions	
	27.	LT of Sinusoidal signals and shifted functions.	
	28.	Waveform synthesis.	
	29.	Initial and Final value theorems.	
	30.	Numerical	
	31.	Numerical	
	32.	Numerical	
V	33.	**Unbalanced Three phase systems**: Analysis of three phase systems.	20
	34.	Calculation of real and reactive powers.	
	35.	**Two Port networks**: Definition, Open circuit impedance,	
	36.	Short circuit admittance and Transmission parameters.	
	37.	And their evaluation for simple circuits.	
	38.	Numerical	
	39.	Numerical	
	40.	Numerical	

13 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	Students study the topics on basic concepts of network theory,Network theorem,Resonant circuits and transient analysis.	Module 1 ,2 and 3 of the syllabus	4	Individual Activity.	Books 1-3 of Text Book list.
2	Assignment 2	Students study the topics laplace transformation, Unbalanced three phase system and two port network.	Module 3 and 4 of the syllabus	9	Individual Activity.	Books 1-3 of Text Book list.

14.0 QUESTION BANK

Module 1

1. Define the following i) Active & Passive elements ii) Independent & Dependent source iii) Power & Energy iv) Bilateral & Unilateral elements. v) Linear & Non-linear elements. vi) Ideal & Practical voltage sources. vii) Ideal & Practical current sources.
2. Explain the procedure for solving the given network using i) mesh analysis, ii) node analysis.
3. Obtain the expression for i) Stat to delta & ii) delta to star transformation.
4. What do you mean by super node & super mesh? Explain with example.
5. Write the loop equations of the circuit and find Vx. in fig.1.1
6. Determine the voltages at node 1 & 2 using nodal analysis in fig 1.2
7. Determine the current supplied by the battery in in fig.1.3.
8. Find the value of R & current through it, in fig.1.4. , when branch AD carries no current.
9. Calculate the power dissipated in 3Ω resistor in fig.1.5.using mesh current analysis.
10. Using source transformation technique, reduce the network given between the terminals AB to a single voltage source network for fig.1.6.
11. For the network shown in fig.1.7, obtain the single delta connected equivalent circuit.
12. For the network shown in fig.1.8 , find the equivalent resistance between AB.
13. Find the current through 10Ω & 5Ω resistor in the circuit shown in fig.1.9.
14. Find the current in 10 ohm resistor in fig.1
15. Reduce the network shown in fig 3 to a single voltage source in series with resistance by source transformation and source shifting.
16. Use mesh analysis to find the current through 4 ohm resistor for the circuit shown in fig 5
17. Find the voltages V1, V2, V3, V4 and current in 1 ohm resistor in fig7

Module 2

1. State and prove superposition theorem.
2. By the superposition theorem calculate the current through (2+j3)Ω impedance branch of the circuit shown in fig.3.1
3. Determine the current in 1Ω resistor across AB of the network shown in fig 3.2 using superposition theorem.
4. Find the current through 5 ohm resistor shown in fig 3.3 and hence verify reciprocity theorem.
5. Obtain the Thevenin's and Norton's equivalent circuits at terminals XY of the network shown in fig.4.1
6. Find the Thevinin's equivalent circuit at terminals a-b of the network shown in fig.4.2 and hence obtain the current through R=10Ω resistor.
7. Obtain the Norton's equivalent circuit of the network shown in fig.4.3 at terminals A&B.
8. State and explain Thevenin's theorem using suitable example.
9. State and explain Norton's theorem using suitable example.
10. Find the current in 3+j4 ohm resistance in using superposition theorem in fig2
11. Find Vx and verify reciprocity theorem in fig 4
12. Using thevinin theorem find the current through R=2 ohm in fig 9
13. Find thevenin equivalent of fig10
14. Using Norton theorem find current in 4ohm resistor in fig 11
15. Find Norton Equivalent of fig12

Module 3

1. What is resonance? What are its types?
2. Explain series resonance? Obtain the condition for resonance
3. Define quality factor and band width & obtain the relationship between them in a series resonance circuit.
4. In case if a series resonant circuit with frequency variation, obtain expression for i)W_c at which maximum voltage occurs across C ii)W_L at which maximum voltage occurs across L & show that $W_L > W_c$
5. Derive the expression for the resonant frequency for a parallel resonance when R_L connected parallel to Rc. Also show that the circuit will resonate at all frequencies if $R_L = R_c = \sqrt{L/C}$
6. Derive the following terms i) Resonance, ii) Bandwidth iii)Selectivity iv)Quality factor, v)Half power frequencies.
7. An RLC series circuit has an inductive coil of RΩ and inductance L Henrys in series with a capacitance of C Farads. The circuit draws a maximum current of 15A, when connected to 230V, 50Hz supply. If the Q factor is 5, find the parameters of the circuit.
8. A series resonance circuit with R = 10Ω, L =0.1H & C =50μF has an applied voltage $V=50\angle 0^0$ volts with a variable frequency, find the resonant frequency, the value of frequency at which maximum voltage occurs across inductor and the value of frequency at which maximum voltage occurs across capacitor.
9. For the circuit shown in fig5.1 determine resonance frequency and the input impedance.
10. Write the comparison between series and parallel resonant circuits
11. Determine RL and RC for the circuit shown in fig1 resonates at all frequencies.
12. Find the resistance of the circuit if circuit draws a current of 10mA at resonance with supply voltage of 50V Find also quality factor of circuit.
13. Define terms i)Resonance ii)Q factor iii)Half power frequencies iv)Bandwidth
14. Obtain an expression for the resonant frequency for the circuit shown in fig2
15. Establish the relationship between quality factor and bandwidth in series resonant circuit and thereby prove that Q=fo/BW

16. In a series RLC network under resonance, voltage across capacitor is 400V and impedance is 100ohm. Bandwidth is 75Hz with applied voltage of 70.7V. Find the R,L,C
17. A 220V, 100Hz AC source supplies a series RLC circuit with a capacitor and a coil. If the coil has 50 mili ohm resistance 5 mH inductance, find at a resonace frequency of 100Hz what is the value of capacitor. Also calculate the Q factor and half power frequencies of the circuit.
18. Why do we need to study initial conditions? Write the equivalent form of the elements in terms of the initial condition of the element.
19. Explain the procedure for evaluating initial conditions with suitable examples.
20. Explain the behavior of resistor, inductor and capacitor elements under transient conditions.
21. Show that the voltage across capacitor and inductor cannot change instantaneously.
22. In the network shown in fig 6.1 the switch K is changed from position a to b at t=0. A steady state having been established at position a, obtain the loop currents a t= o+
23. In the network shown in fig 6.2 the capacitor C1 is charged to voltage V0 = 1000v and the switch K is opened at t=0. solve for d^2i_z/dt^2 at $t=0^+$
24. The network shown in fig 6.3 has the switch K opened at t=0. Solve for v, dv/dt, d^2v/dt^2 at t=0+
25. Q1.Determine V, dV/dt and d^2V/dt^2 at t=0+ when the switch K is opened at t=0 in fig 3, R=100ohm, L=1H and I=2A
26. Q2.In the circuit a fig4 the switch is opened at t=0 find the values of V, dV/dt and d^2V/dt^2 at t=0+
27. Q3.Determine i, di/dt, d^2i/dt^2 at t=0+ when the switch K is moved from position 1 to 2 at t=0 in network shown in fig5
28. Q4.In the network shown in fig6, K is changed from position a to b at t=0, solve for i, di/dt, d^2i/dt^2 at t=0+, Assume that capacitor is initially uncharged.

Module 4

1. State and prove initial value and final value theorem.
2. What are the limitations of initial and final value theorem.
3. State and prove convolution theorem
4. Define and obtain the Laplace transform of i)UNIT impulse function ii)UNIT ramp function iii)UNIT step function
5. Obtain the Laplace transform of full wave rectified sine wave of amplitude 1 and period πsec.
6. Determine the current expression Vo(t) in the circuit shown in fig.7.1, when the switch S is closed at t=0.The inductor is initially de-energized.
7. Find the response of current of a series R-L circuit consisting of R=4Ω, L=2H, when each of the following driving force voltages are applied
8. i) UNIT ramp voltage r(t-5) ii) UNIT impulse voltage δ(t-5)
9. iii) UNIT sep voltage U(t-5)Assume zero initial conditions.
10. For the circuit shown in fig.7.2 Find vo(t) using convolution theorem.
11. A pulse voltage of magnitude 5 and duration 1 sec is applied to a series RC circuit having R=5Ω, C=0.2f. Calculate the current i(6) in the circuit using Laplace transform.

Module 5

1. Explain i) Z-parameters ii) Y-Parameters iii) Transmission parameters, iv) Hybrid parameters v)Inverse transmission parameter vi) inverse hybrid parameters.
2. Obtain relation between
3. i)Y & Z parameters ii)Y & h parameters iii)Y & ABCD parameters iv)Z & h Parameters v)Z & T parameters
4. vi)H & T parameters
5. Two 2port networks are connected in cascade obtain T-parameters of the inter connected network interms of T parameters of the individual networks.

6. A two port network in terms of Z-parametrs is said to be symmetric if Z11=Z22 and reciprocal if Z12= Z21. Obtain the corresponding conditions in terms of i) h Parameters ii) T-parameters using the relationship between different two-port parameters.
7. Obtain ABCD parameters in terms of z-parameters and show that AD-BC = 1
8. Find the relationship between the z-parameters and h-parameters of a two port network.
9. Define Z and Y parameters of a 2 port network.
10. Define Z- parameters. Express Z-parameters in terms of Y parameters.
11. Find Z and Y parameters for the two-port network shown in fig.8.1
12. Following are the hybrid parameters of the network given. Define the Y parameters for the network.
13. $\begin{matrix} h11 & h12 \\ h21 & h22 \end{matrix} = \begin{matrix} 5 & 2 \\ 3 & 6 \end{matrix}$
14. Write explanation on star connected three phase network and delta connected three phase network.

Sample networks for the question bank given (fig 1.1 to 3.2)

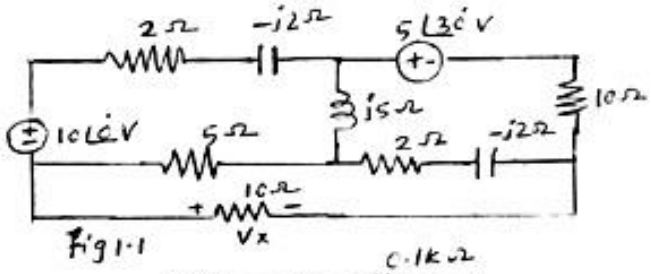


Fig 1·1

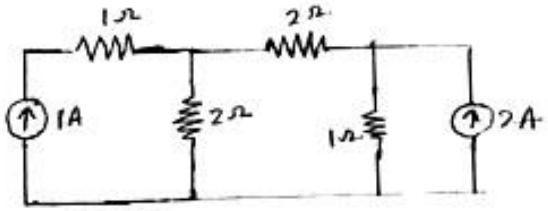


Fig 1·2

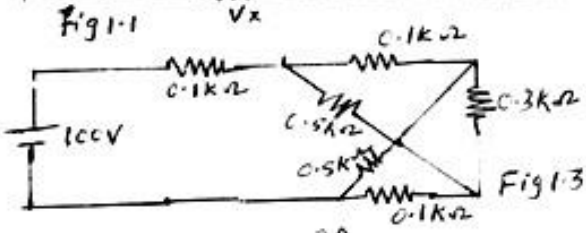


Fig 1·3

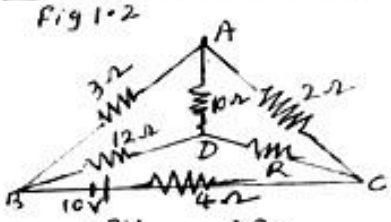


Fig 1·4.

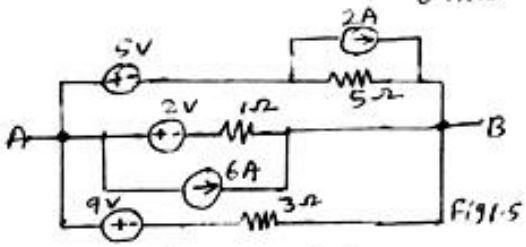


Fig 1·5

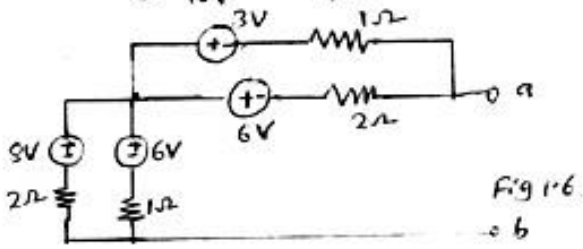


Fig 1·6

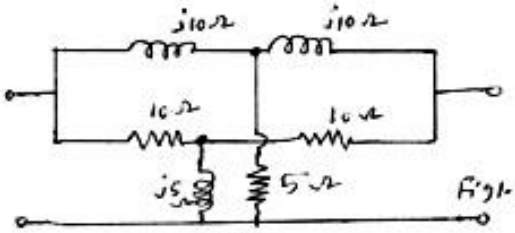


Fig 1·7

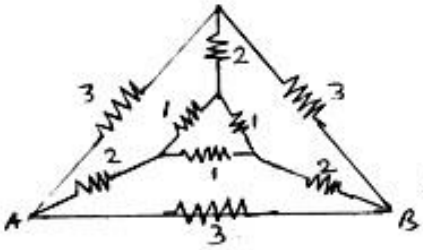


Fig 1·8

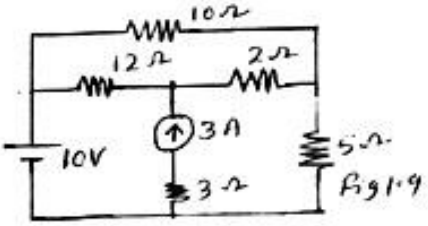


Fig 1·9

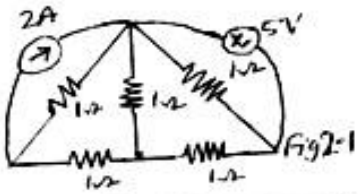


Fig 2·1

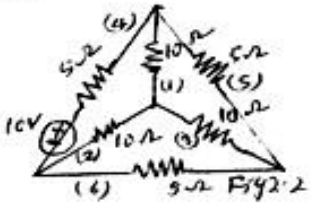


Fig 2·2

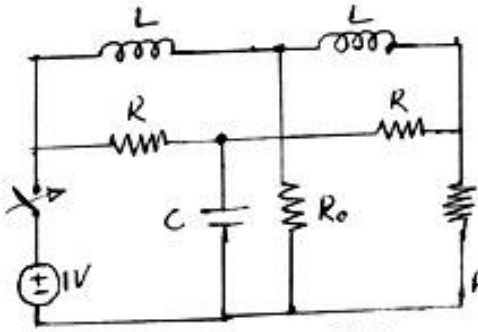


Fig 2·3.

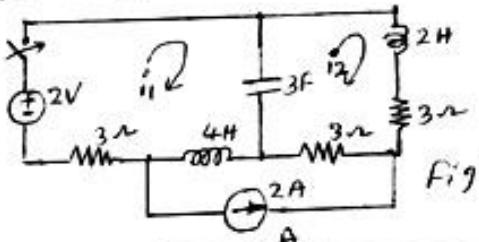


Fig 2·4

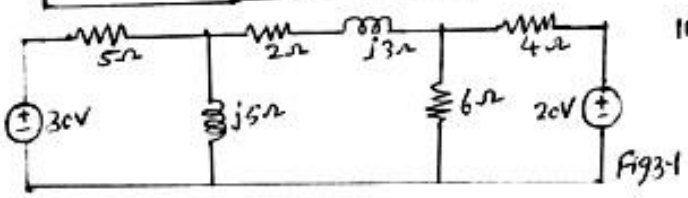


Fig 3·1

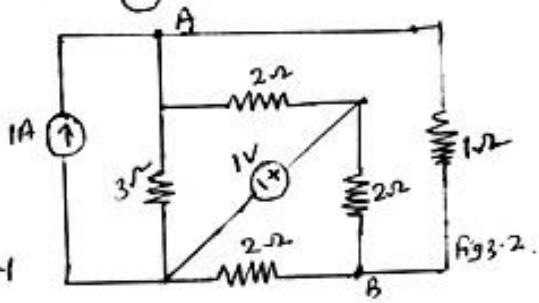


Fig 3·2.

Sample circuits for the question bank given (fig3.3 to 8.1)

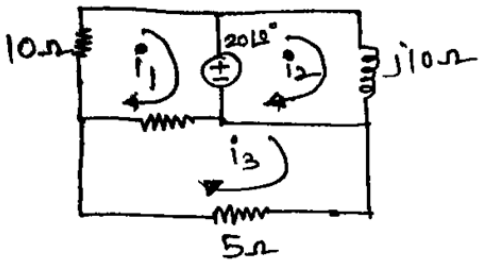


fig 3.3

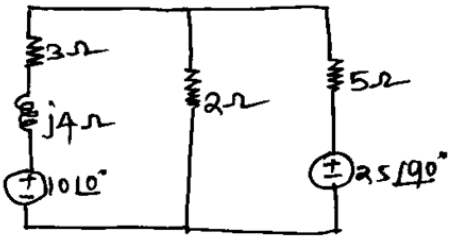


fig 3.4

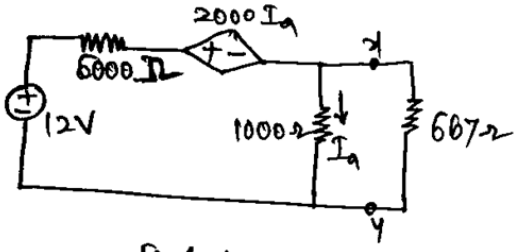


fig4.1

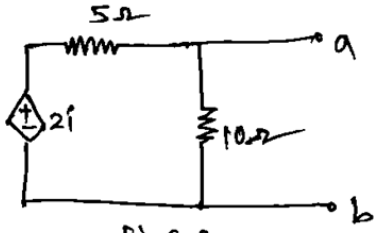


fig4.2

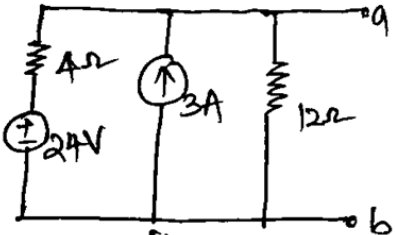


fig4.3

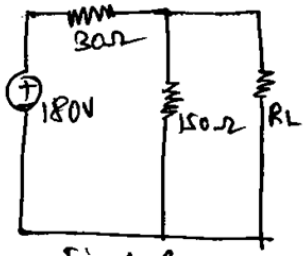


fig 4.4

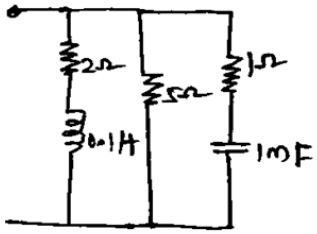


fig 5.1

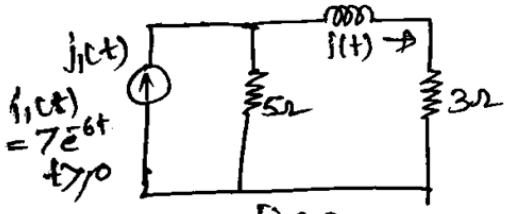


fig6.2

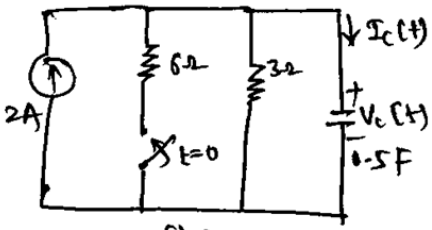


fig 6.1

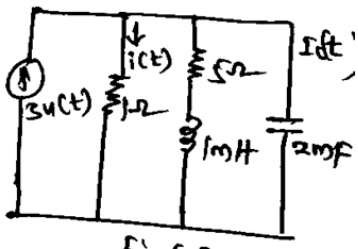


fig 6.3

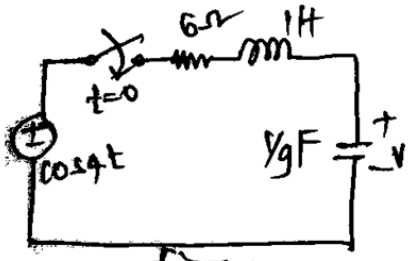


fig7.1

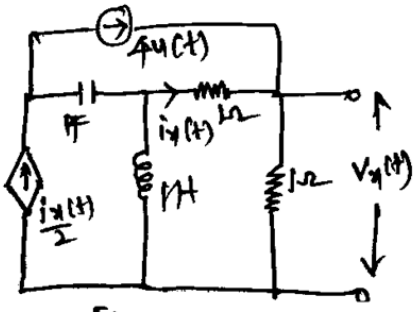


fig7.2

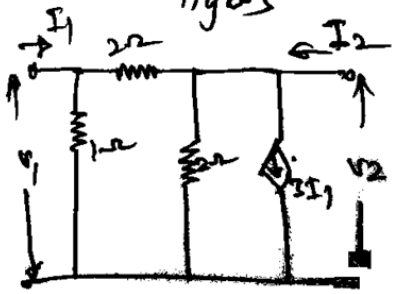


Fig 8.1

Circuits on network reduction techniques and KVL, KCL(fig 1-fig 8)

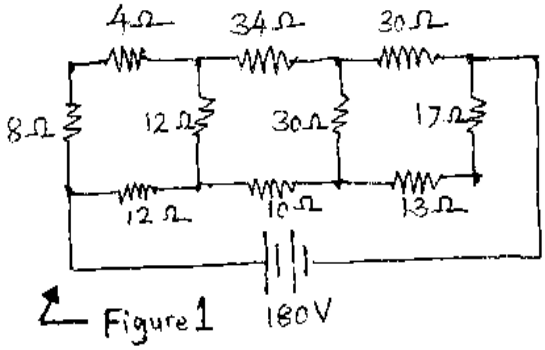


Figure 1

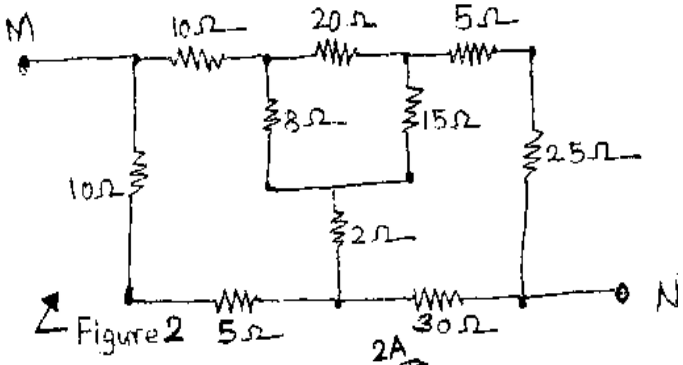


Figure 2

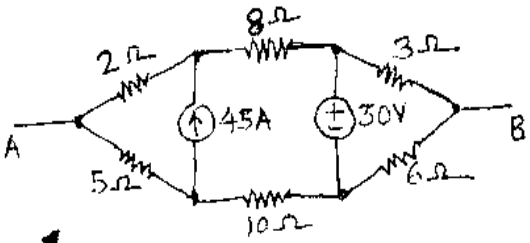


Figure 3

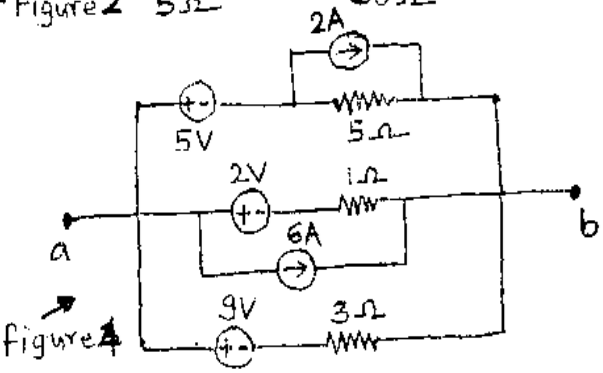


Figure 4

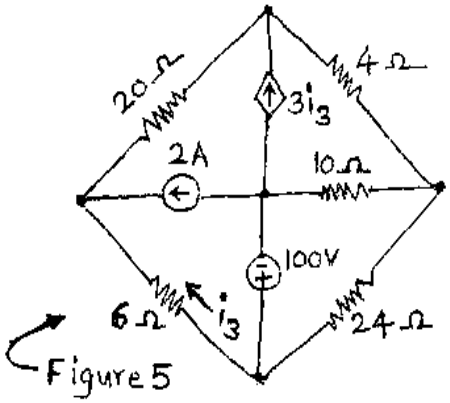


Figure 5

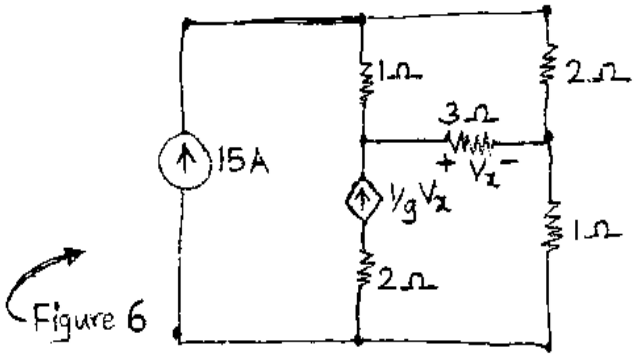


Figure 6

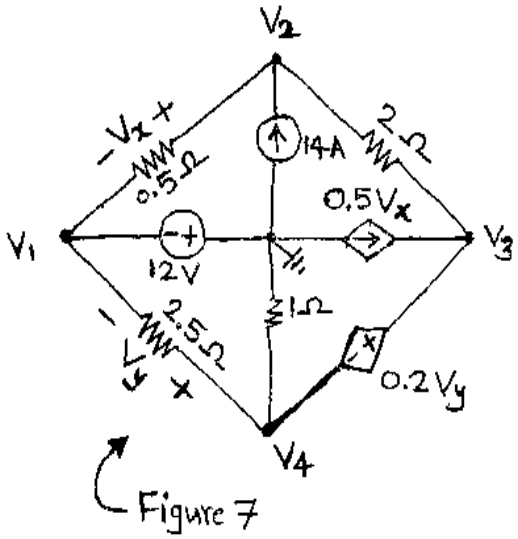


Figure 7

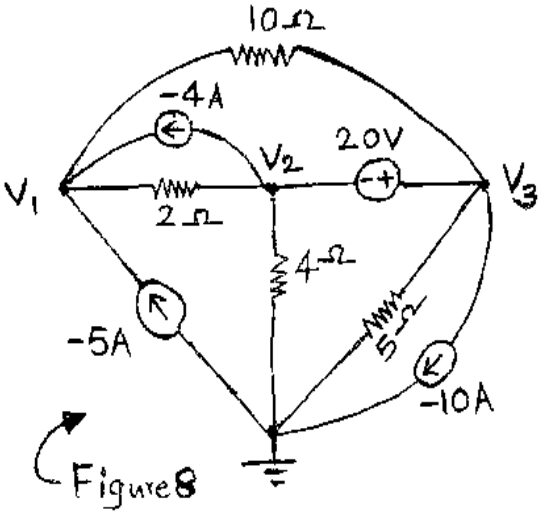


Figure 8

Sample Circuits on network theorems.(fig 1-fig12)

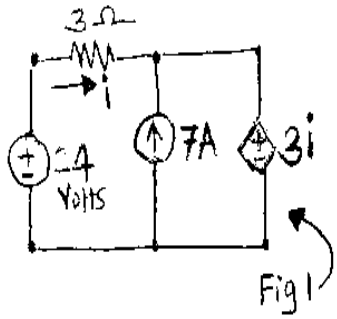


Fig 1

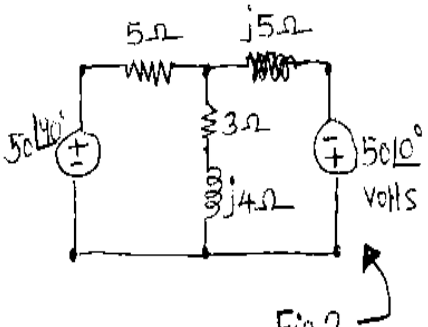


Fig 2

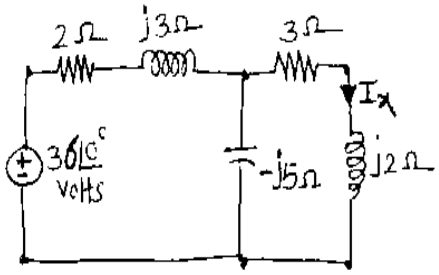


Fig 3

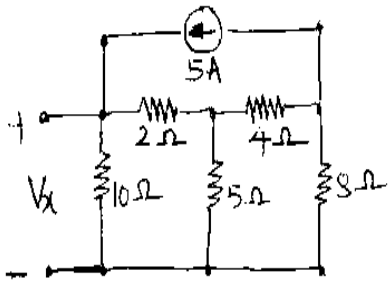


Fig 4

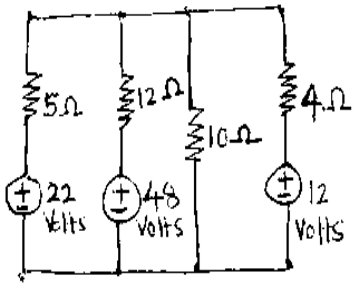


Fig 5

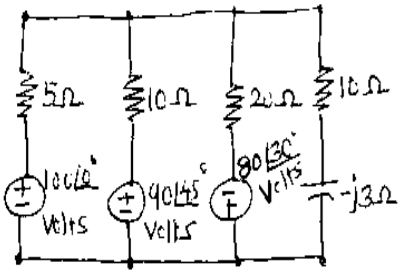


Fig 6

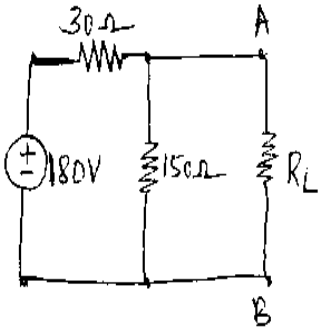


Fig 7

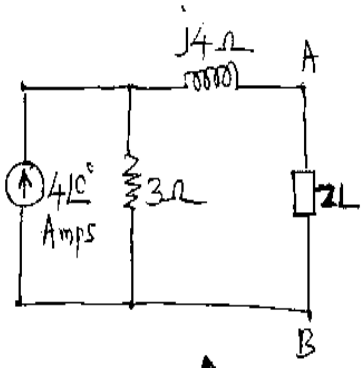


Fig 8

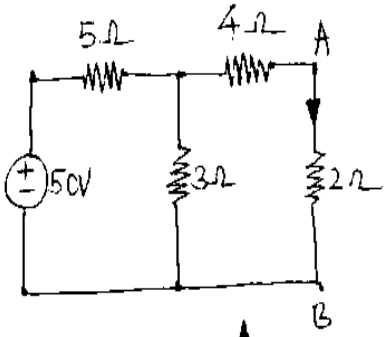


Fig 9

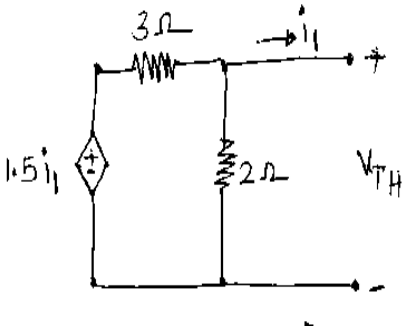


Fig 10

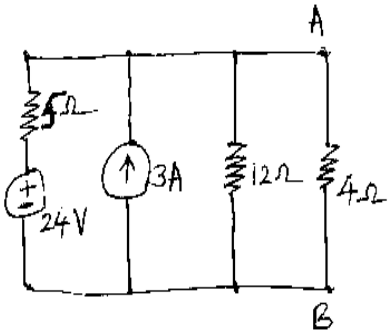


Fig11

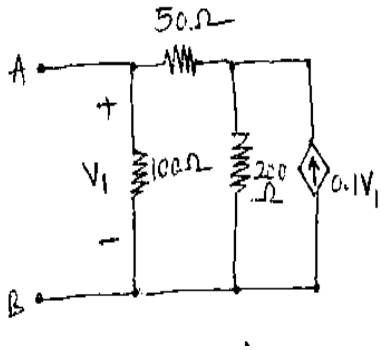
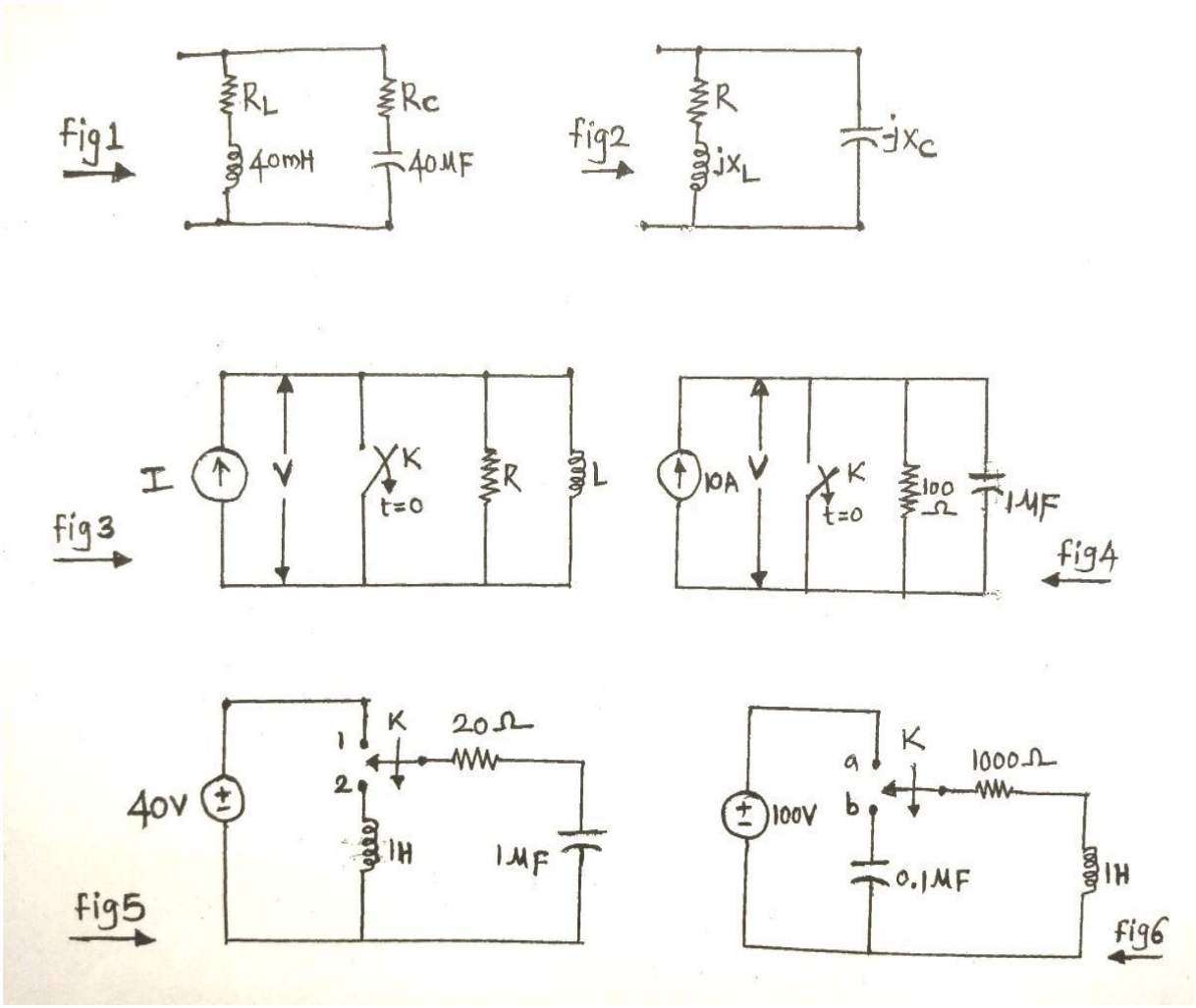


Fig 12

Sample networks on resonance, transient analysis



Prepared by	Checked by		
31/10/22	31/10/2022	31/10/22	
Prof. Amit Neshti	Prof. Shivanand Hirekodi	HOD	Principal

Subject Title	**Transformers and Generators**		
Subject Code	21EE34	**CIE Marks**	50
Number of Lecture Hrs /	2:2:0:0	**SEE Marks**	50
Total Number of Lecture Hrs	40	**Exam Hours**	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Prof. Mahesh Yenagimath	**Designation:** Asst. Professor	**Experience:** 16 Years
No. of times course taught: 01 (including present)	**Specialization:** VLSI & ES	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electrical Engineering

2.0 Course Objectives

1. To understand the concepts of transformers and their analysis.
2. To suggest a suitable three phase transformer connection for a particular operation.
3. To understand the concepts of generator and to evaluate their performance.
4. To study regulation of AC Generators using different methods.
5. To explain the requirement for the parallel operation of transformers and synchronous generators.

3.0 Course Outcomes

Having successfully completed this course, the student will be able

	Course Outcome	RBT Level	POs
C204.1	Discuss the principle of operation, construction and performance evaluation of 1-phase, 3-Phase transformers and Autotransformer.	L3	PO 1,2,3,6,7,8,9,10,12
C204.2	Explain the parallel operation of transformer and discuss about autotransformer and tap changing transformer.	L2	PO 1,2,3,6,7,8,9,10,12
C204.3	Describe the fundamental concepts of DC and Synchronous Generator.	L2	PO 1,2,3,6,7,8,9,10,12
C204.4	Determine the regulation of Synchronous Generator by EMF, MMF and ZPF Methods.	L3	PO 1,2,3,6,7,8,9,10,12
C204.5	Analyze the performance of Synchronous Generator.	L3	PO 1,2,3,6,7,8,9,10,12
Total Hours of instruction		**40**	

4.0 Course Content

Module-1

Single phase Transformers: Operation of practical transformer under no-load and on-load with phasor diagrams. Open circuit and Short circuit tests, calculation of equivalent circuit parameters and predetermination of efficiency-commercial and all-day efficiency. Voltage regulation and its significance.

Three-phase Transformers: Introduction, Constructional features of three-phase transformers. Choice between single unit three-phase transformer and a bank of three single-phase transformers. Transformer connection for three phase operation– star/star, delta/delta, star/delta, zigzag/star and V/V, comparative features. Phase conversion-Scott connection for three-phase to two-phase conversion. Labeling of three-phase transformer terminals, vector groups.

8 hours

Module-2

Tests, Parallel Operation of Transformer& Auto Transformer: Polarity test, Sumpner's test, separation of hysteresis and eddy current losses

Parallel Operation of Transformers: Necessity of Parallel operation, conditions for parallel operation– Single phase and three phase. Load sharing in case of similar and dissimilar transformers.

Auto transformers and Tap changing transformers: Introduction to autotransformer-copper economy, equivalent circuit, no load and on load tap changing transformers

8 hours

Module-3

Three-Winding Transformers & Cooling of Transformers: Three-winding transformers. Cooling of transformers.

Direct current Generator: Armature reaction, Commutation and associated problems,

Synchronous Generators: Armature windings, winding factors, e.m.f equation. Harmonics–causes, reduction and elimination. Armature reaction, Synchronous reactance, Equivalent circuit.

8 hours

Module-4

Synchronous Generators Analysis: Alternator on load. Excitation control for constant terminal voltage. Voltage regulation. Open circuit and short circuit characteristics, Assessment of reactance-short circuit ratio, synchronous reactance, Voltage regulation by EMF, MMF and ZPF

8 hours

Module-5

Synchronous Generators (Salient Pole): Effects of saliency, two-reaction theory, Parallel operation of generators and load sharing. Methods of Synchronization, Synchronizing power, Determination of Xd & Xq – slip test

Performance of Synchronous Generators: Power angle characteristic (salient and non salient pole), power angle diagram, reluctance power, Capability curve for large turbo generators. Hunting and damper windings.

8 hours

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	IV	Electric motors	Principles of
02	VII&VIII	Seminar and project	Knowledge of Machine

6.0 Relevance to Real World

SL No	Real World Mapping
01	Generators and Transformers are used in power generation, transmission and distribution.
02	Energy-intensive industrial applications.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Lab and industrial visit.	Familiarization of real machine parts and its constructional features. and demonstrating the working of various machines.
02	NPTEL	Assembly Application

8.0 Books Used and Recommended to Students

Text Books
1. Electric Machines', D. P. Kothari,I. J. Nagrath Mc Graw Hill 4th edition, 2011
2. Principles of electric machines by V K Mehta, Rohit Mehta, S Chand, 2nd Edition 2009.
Reference Books
1. Electric Machines by Mulukuntla S, Cengage, 1st Edition, 2009
2. Electrical Machines, Drives and Power systems by Theodore Wildi, Pearson, 6th Edition, 2014.
3. Electric Machines by Ashfaq Hussain, Dhanpat Rai & Co, 2nd Edition 2013
Additional Study material & e-Books
1. Transformers & Generators by Bakshi, Technical publications
2. Electrical Machines M.V. Deshpande PHI Learning 2013
3. Electric Machines R.K. Srivastava Cengage Learning 2nd Edition,2013
4. Principles of Electric Machines and power Electronics P.C.Sen Wiley 2nd Edition, 2013
5. Electric Machinery and Transformers Bhag S Guru at el Oxford University Press 3rd Edition, 2012
6. Theory of Alternating Current Machines Alexander Langsdorf Mc Graw Hill 2nd Edition, 2001

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

Website and Internet Contents References
1) http://www.electrical4u.com
2) www.nptel.com
3) https://en.wikipedia.org/wiki/Transformer
4) https://www.youtube.com/watch?v=LAtPHANEfQo
5) www.electrical4u.com/**transformer**/
6) http://www.electrical4u.com/working-principle-of-dc generator and alternator/
7) www.ijset.net/journal/68.pdf
8) www.electrical4u.com/**dc**generator
9) www.electrical4u.com/**alternator**
10) www.electricaleasy.com/…/**alternator**
11) http://eeeinterviewtips.blogspot.in/2011/09/discuss-different-types-of-generator

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	EC&M Magazines	http://ecmweb.com/ops-maintenance/generators
2	Oil & gas journal	https://www.sub-forms.com/dragon/init.do?site=PNW23_Ogogpenew
3	IPT Magazine	https://www.intelligent-power-today.com/
4	Electric apparatus magazine	https://electricalapparatus.wordpress.com/2016/06/30/electric-generator-up-and-running/
5	E drive magazine	http://www.e-driveonline.com/main/
6	Motor magazine	https://www.motor.com/newsletters/20110410/WebFiles/ID1_IonizingAmerica.html

11.0 Examination Note

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)** at the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks** (to have less stressed CIE, the portion of the syllabus should not be common / repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1	1.	**Single phase Transformers:** Operation of practical transformer under no-load and on-load with phasor diagrams.	20%
	2.	Open circuit and Short circuit tests,	
	3.	Calculation of equivalent circuit parameters and predetermination of efficiency-commercial and all-day efficiency.	
	4.	Voltage regulation and its significance.	
	5.	**Three-phase Transformers:** Introduction, Constructional features of three-phase transformers.	
	6.	Choice between single unit three-phase transformer and a bank of three single-phase transformers.	
	7.	Transformer connection for three phase operation– star/star, delta/delta, star/delta, zigzag/star and V/V, comparative features.	
	8.	Phase conversion-Scott connection for three-phase to two-phase conversion. Labeling of three-phase transformer terminals, Vector groups.	
2	9.	**Tests, Parallel Operation of Transformer& Auto Transformer:** Polarity test**.** Sumpner's test.	20%
	10.	Separation of hysteresis and eddy current losses.	
	11.	**Parallel Operation of Transformers:** Necessity of Parallel operation,	
	12.	Conditions for parallel operation– Single phase and three phase.	
	13.	Load sharing in case of similar and dissimilar transformers.	

	14.	**Auto transformers and Tap changing transformers:** Introduction to autotransformer-copper economy.	
	15.	Equivalent circuit	
	16.	No load and on load tap changing transformers	
3	17.	**Three-Winding Transformers & Cooling of Transformers**: Three-winding transformers.	20%
	18.	Cooling of transformers.	
	19.	**Direct current Generator:** Armature reaction	
	20.	Commutation and associated problems,	
	21.	**Synchronous Generators:** Armature windings, winding factors, e.m.f equation.	
	22.	Harmonics–causes, reduction and elimination.	
	23.	Armature reaction.	
	24.	Synchronous reactance, Equivalent circuit.	
4	25.	**Synchronous Generators Analysis:** Alternator on load.	20%
	26.	Excitation control for constant terminal voltage.	
	27.	Voltage regulation.	
	28.	Open circuit and short circuit characteristics,	
	29.	Assessment of reactance-short circuit ratio, synchronous reactance,	
	30.	Voltage regulation by EMF method	
	31.	Voltage regulation by MMF method	
	32.	Voltage regulation by ZPF method	
5	33.	**Synchronous Generators (Salient Pole):** Effects of saliency, two-reaction theory.	20%
	34.	Parallel operation of generators and load sharing.	
	35.	Methods of Synchronization, Synchronizing power,	
	36.	Determination of Xd & Xq – slip test	
	37.	**Performance of Synchronous Generators:** Power angle characteristic (salient and non salient pole).	
	38.	Power angle diagram, reluctance power,	
	39.	Capability curve for large turbo generators.	
	40.	Hunting and damper windings.	

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 single phase and three phase transformer.	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1, 2 & 3 of the syllabus	4	Individual Activity. Printed solution expected.	Book 1,2 of the textbooks list.
2	Assignment 2: University Questions on autotransformer	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4,5 of the syllabus	9	Individual Activity. Printed solution expected.	Book 1,2 of the textbooks list.

14.0 QUESTION BANK

Module 1

1. Explain with neat sketch the construction of single phase core type and shell type transformer?
2. Difference between shell and core type transformer?
3. Explain in brief the working principle of single phase transformer.
4. Derive the EMF equation of a transformer.
5. Explain in brief Starting from fundamental develop the exact equivalent circuit and approximate equivalent circuit of a single phase transformer referred to primary?
6. Draw the phasor diagrams of single phase transformer with unity pf and lagging pf loads.
7. Draw the phasor diagrams of single phase transformer with unity pf and lagging pf loads.
8. Explain how the flux in the core of transformer remains constant, from no load to full load. Develop the phasor diagram of an actual transformer when it is inductively loaded.
9. Explain in details OC and SC test (with circuit diagram) for determination of efficiency and regulation of single phase transformer.
10. What are the losses in a transformer? How to reduce these losses? Derive the condition for maximum efficiency? Efficiency and voltage regulation of transformer
11. Define all day efficiency and explain
12. Write a short note on efficiency and voltage regulation of transformer.
13. Discuss the ideal transformer & practical transformer under load and no load.
14. Explain the Necessary conditions for parallel operation of single phase transformers and then the three phase .
15. Explain the classification of polyphase connection of three phase transformer.
16. Discuss the Phase conversion – Scott connection for three-phase to two-phase conversion.
17. Discuss the Labeling of three-phase transformer terminals & vector groups.
18. Discuss the Equivalent circuit of three phase transformers.

Module 2

1. Discuss the Objects of testing transformers & polarity test.
2. Explain With neat diagram explain in detail Sumpner's test for determining the efficiency and voltage regulation of transformer. Mention its advantages and disadvantages.
3. Explain the separation of hysteresis and eddy current losses in a transformer.
4. Describe the necessity parallel operation of transformers
5. Explain the Necessary conditions for parallel operation of single phase transformers and then the three phase.
6. Discuss the Load sharing in case of similar and dissimilar transformers.
7. What is an autotransformer? Derive an expression for the saving of copper when an autotransformer is used? Mention its applications?
8. What is an autotransformer? Discuss merits and demerits of autotransformer?
9. Discuss the equivalent circuit, three phase autotransformer connection and voltage regulation.
10. Discuss the Voltage regulation by tap changing – off circuit and on load.
11. Discuss the Necessity of tertiary winding, equivalent circuit and voltage regulation.
12. Discuss the tertiary winding in star/star transformers & rating of tertiary winding.

Module 3

1. Explain the method of cooling of transformers.
2. Explain the construction of three winding transformers.
3. Explain the armature reaction in synchronous generators.
4. Draw and explain the equivalent circuit of synchronous generators.
5. Explain the causes & effects of harmonics generated by transformers.
6. Explain the Current inrush in transformers & generation of noise in transformer.
7. With neat diagram explain the phenomenon of armature reaction in d.c machine.
8. Develop an expression for demagnetizing and cross magnetizing armature ampere turns in a d.c generator.
9. With the neat diagram explain the process of commutation in the d.c machine.

10. Explain the methods of improving the commutation.
11. Explain what is meant by critical field resistance in a d.c shunt generator & explain the method of determining it.
12. Explain why interpoles and compensating winding are used in d.c machine.
13. List the advantage of stationary armature in synchronous machine.
14. Explain the essential difference between cylindrical and salient pole rotors used in large alternators.
15. List the advantage of chording of armature coils in synchronous machine. Derive the expression for pitch factor.
16. Define the breadth factor. Derive expression for it.
17. Derive an equation for emf induced in an alternator.
18. Write a short note on armature reaction in alternator.
19. Discuss the various measures adopted in a practice to make the waveform of large alternators to be closely sinusoidal.
20. Explain the Harmonics – causes, reduction and elimination in an alternator.
21. Discuss the Synchronous reactance & Equivalent circuit in an alternator.

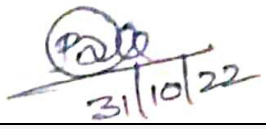
Module 4

1. Discuss the Synchronous generator load characteristics.
2. Explain the excitation control for constant terminal voltage of synchronous generator.
3. An alternator is supplying constant load. With suitable vector diagram and explain the effect of variation on excitation on armature current and power factor.
4. Explain the open circuit and short circuit characteristics of synchronous generator.
5. Explain how two or more alternators are made to share the load in proportion to rating.
6. Derive an expression for mechanical power developed by salient pole synchronous motor Hence Explain what is meant by reluctance torque.
7. With neat circuit diagram, explain how an alternator is synchronized with bus bars.
8. Discuss the Electrical load diagram & mechanical load diagram.
9. Define" Regulation of alternator ". Explain ASA method of finding the Regulation of alternator. And compare with other known method.
10. Define" Regulation of alternator". Explain MMF or ampere turn's method of finding the Regulation of alternator.
11. Describe synchronous impedance method to determine the regulation of alternator for lagging and leading power factor.
12. Define" Regulation of alternator ". Explain potier reactance method of finding the Regulation of alternator.

Module 5

1. Explain the effect of saliency of synchronous generators.
2. Explain the methods of synchronization of synchronous generators.
3. Explain the effect of two reaction theory of synchronous generators.
4. With neat circuit diagram explain the slip test of salient Pole synchronous machine and indicate X_d and X_q can be determined from the test.
5. Obtain expression for power angle equation of salient Pole synchronous generator Connected to infinite bus bar. Sketch this characteristic this characteristic and comment on it shape.
6. With. Neat circuit diagram, Derive an expression for the power output of salient Pole synchronous generator Draw variation of power versus load angle.
7. With the usual notations derive an expression for synchronizing power and torque when two alternators are connected in parallel.
8. List the conditions to be fulfilled to connect two alternators in parallel.

9. Why is alternator terminal voltage, when loading is not equal to the no load voltage.
10. Discuss Capability curve for large turbo generators and salient pole generators.
11. Discuss the Starting, synchronizing and control.
12. Discuss the Hunting and damper winding.

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

Subject Title	**ELECTRICAL MACHINES LABORATORY - 1**		
Subject Code	21EEL35	**CIE Marks**	50
No. of Lecture hrs./Week (L:T:P:S)	0:0:2:0	**SEE Marks**	50
		Exam Hours	03
			CREDITS – 01

FACULTY DETAILS:		
Name: Prof. S G Huddar	**Designation:** Asst. Professor	**Experience:** 08 Years
No. of times course taught: 01 Times	**Specialization:** Power System Engineering	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I	Basic electrical Engineering

2.0 Course Objectives

- Conducting of different tests on transformers and synchronous machine and evaluation of their performance.
- Verify the parallel operation of two single phase transformers of different KVA rating.
- Study the connection of single phase transformers for three phase operation and phase conversion.
- Study of synchronous generator connected to infinite bus.

3.0 Course Outcomes

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

CO	Course Outcome	RBT Level	POs
CO205.1	Evaluate the performance of transformers from the test data obtained.	L_1,L_2,L_3,L_4,L_5	1,2,9,10
CO205.2	Explain the operation of two single phase transformers of different KVA rating connected parallel fashion.	L_1,L_2	1,2,9,10
CO205.3	Explain the operation of three single phase transformers for three phase operation and phase conversion.	L_1,L_2	1,2,9,10
CO205.4	Determine the voltage regulation of synchronous generator using the test data obtained in the laboratory.	L_1,L_2,L_3	1,2,9,10
CO205.5	Evaluate the performance of synchronous generators from the test data and assess the performance of synchronous generator connected to infinite bus.	L_1,L_2,L_3,L_4,L_5	1,2,9,10
Total Hours of instruction		**24**	

4.0 Course Content

Experiments

1. Open Circuit and Short circuit tests on single phase step up or step down transformer and pre-determination of (i) Efficiency and regulation (ii) Calculation of parameters of equivalent circuit.
2. Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.
3. Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given data using Short circuit test data
4. Polarity test and connection of 3 single-phase transformers in star-delta and determination of efficiency and regulation under balanced resistive load.
5. Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load.
6. Scott connection with balanced and unbalanced loads.
7. Separation of hysteresis and eddy current losses in single phase transformer.
8. Voltage regulation of an alternator by EMF and MMF methods.
9. Voltage regulation of an alternator by ZPF method.
10. Power angle curve of synchronous generator or Direct load test on three phase synchronous generator to determine efficiency and regulation.

11. Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines.
12. Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	IV	Machine Lab-2	Construction, working & operation of different types of machines.
02	IV	Electric motors	

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Energy Regeneration Material Handling Oil and Gas Mining and Drilling Industry (Hazardous Environment)
02	Off-highway Sector, Automotive Marine, Pump Drives

7.0 Books Used and Recommended to Students

Text Books
1.Electric Machines', D. P. Kothari,I. J. Nagrath Mc Graw Hill 4th edition, 2011 2.Electrical Machines M.V. Deshpande PHI Learning 2013 3.Electric Machines R.K. Srivastava Cengage Learning 2nd Edition,2013
Reference Books
1.Principles of Electric Machines and power Electronics P.C.Sen Wiley 2nd Edition, 2013 2.Electrical Machines, Drives and Power systemsTheodore Wildi Pearson 6th Edition, 2014. 3.Electric Machinery and Transformers Bhag S Guru at el Oxford University Press 3rd Edition, 2012 4.Theory of Alternating Current Machines Alexander Langsdorf Mc Graw Hill 2nd Edition, 2001
Additional Study material & e-Books
Electric machines by godse & bakshi

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

Website and Internet Contents References
1) www.electrical4u.com/**transformer**/ 2) http://www.electrical4u.com/working-principle-of-dc generator and alternator/ 3) www.ijset.net/journal/68.pdf 4) www.electrical4u.com/**dc generator** 5) www.electrical4u.com/**alternator**

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	EC&M Magazines	http://ecmweb.com/ops-maintenance/generators
2	Oil & gas journal	https://www.sub-forms.com/dragon/init.do?site=PNW23_OGogpenew
3	IPT Magazine	https://www.intelligent-power-today.com/
4	Electric apparatus magazine	https://electricalapparatus.wordpress.com/2016/06/30/electric-generator-up-and-running/

10.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

Each experiment to be evaluated for conduction with observation sheet and record write-up.

Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.

- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the **8th** week of thesemester and the second test shall be conducted after the **14th** week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge willcarry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the totalCIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. Writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scoredmarks shall be scaled down to 50 marks

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

11.0 Course Delivery Plan

Expt. No.	Aim of the Experiment	% of Portion
1.	Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of (i) Efficiency and regulation (ii) Calculation of parameters of equivalent circuit.	8.33
2.	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.	8.33
3.	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification of data using Short circuit test data.	8.33
4.	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.	8.33
5.	Comparison of performance of 3 single-phase transformers in delta –delta and V – V(open delta) connection under load.	8.33
6.	Scott connection with balanced and unbalanced loads.	8.33
7.	Separation of hysteresis and eddy current losses in single phase transformer.	8.33
8.	Voltage regulation of an alternator by EMF and MMF methods.	8.33
9.	Voltage regulation of an alternator by ZPF method.	8.33
10.	Power angle curve of synchronous generator.	8.33
11.	Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines.	8.33
12.	Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.	8.33

12.0 QUESTION BANK

1. Define Transformer?
2. Mention different classifications of Transformer?
3. Give the constructional details of the core & winding part of the transformer,
4. Compare core type & shell type transformers.
5. Power transformer are designed to give good
    a. all day efficiency b) power efficiency
6. Distribution transformer are designed to give good
    a. all day efficiency b) power efficiency
7. Transformer is "Constant flux Machine" True/False, Justify
8. Give the classification of transformers in details.
9. Draw the phasor diagram for single phase transformer considering,
    a. Resistive Load b) Inductive Load c) Capacitive Load
10. Draw the Exact & approximate Equivalent Electric Circuit of single phase transformer
11. What do you mean by the term "Voltage Regulation of Transformer?
12. Give the expression for the Voltage regulation in terms of approximate voltage drop.
13. Give the condition for maximum power efficiency of the transformer, Use the condition to decide the KVA load to be applied on the transformer to give maximum efficiency.
14. Give the comparison between Power efficiency & Energy efficiency.
15. Give the importance of Energy efficiency in case of Distribution Transformer & that of Power efficiency in case of Power transformer.
16. Mention & justify the conditions for parallel operation of the transformers.
17. Write the expressions for power shared by two unequal voltage ratios transformer.
18. What is zero voltage regulation, Give the condition for the same?
19. What do you mean by Testing of transformers, why is it required?
20. Give the comparison between OC, SC & Back to Back Test.
21. What do you mean by predetermination of Efficiency & Regulation of transformers?
22. Give the procedural details of finding efficiency & regulation of the transformers at different load condition.
23. Write the voltage current relationships at primary & secondary of star Delta transformer.
24. Mention the applications where 2-phase supply is required, Explain how 3-phase to 2-phase conversion is achieved in case of Scott connection.
25. How are alternators classified?
26. Name the types of alternator based on their rotor construction.
27. Why do cylindrical alternators operate wth steam turbines?
28. Which type of synchronous generators are used in hydro-electric plants and why?
29. What are the advantages of salient pole type construction used for synchronous machines?
30. Why is stator core of alternator laminated?
31. How does electrical degree differ from mechanical degree?
32. What is distributed winding?
33. Why short pitch s preferred over full pitch winding?
34. Define winding factor.
35. Why alternators rated in KVA and not in MW?
36. What are the causes of changes in voltage in alternators when loaded?
37. What you meant by armature reaction in alternators/
38. What is meant by synchronous impedance of a alternator?
39. What you mean by synchronous reactance ?
40. What is meant by load angle of an alternator?
41. Upon what factor does load angle depend?
42. Define the terminal voltage of alternator.
43. What is the necessesity for predetermination of voltage regulation?
44. How synchronous impedance is calculated from OCC and SCC?
45. Why is EMF method called as pessimistic method?
46. In what way does ampere turn method differ from emf method?
47. State the conditions to be satisfied before connecting two alternators in parallel.
48. How synchronous cope is used for synchronizing alternators?
49. List the factors that affect the load sharing in parallel operating generators?
50. How the change in excitation does affect the load sharing?
51. What is meant by infinite bus bars?
52. Why MMF method is called as optimistic method?
53. Why is the resistance of field winding of a d.c shunt generator kept low?

54. What will happen if a d.c machine is operated below the rated speed?
55. What do you understand by the external characteristics of a d.c generator?
56. What you mean by V and inverted V curve of synchronous motor.

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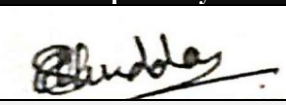	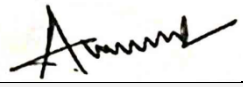	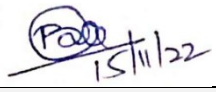	
Prof. S. G. Huddar	**Prof. A. U. Neshti**	**HOD**	**Principal**

Subject Title	**555 IC Laboratory**		
Subject Code	21EEL383	**CIE Marks**	50
No. of Lecture hrs./Week (L:T:P:S)	0:0:2:0	**SEE Marks**	50
		Exam Hours	02
			CREDITS – 01

FACULTY DETAILS:		
Name: Prof. K. B. Negalur	**Designation:** Asst. Professor	**Experience:** 09 Years
No. of times course taught: 01 Times	**Specialization:** Industrial Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electronics Engineering

2.0 Course Objectives

- Along with prescribed hours of teaching –learning process, provide opportunity to perform the experiments/programmes at their own time, at their own pace, at any place as per their convenience and repeat any number of times to understand the concept.
- Provide unhindered access to perform whenever the students wish.
- Vary different parameters to study the behavior of the circuit without the risk of damaging equipment/device or injuring themselves.

3.0 Course Outcomes

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

CO	Course Outcome	RBT Level	POs
CO212	Analyse in an intelligent manner, think better, and perform better.	L_1,L_2,L_3,L_4,L_5	PO1-PO12
Total Hours of instruction		**24**	

4.0 Course Content

Experiments

1. Construct Astable Multivibrator circuit using IC-555 Timer.
2. Construct Mono-stable Multivibrator circuit using IC-555 Timer.
3. Construct and test Sequential timer using IC-555.
4. Generate Pulse Width Modulator (PWM) signal using IC-555 Timer.
5. Construct Burglar Alarm circuit using IC-555 Timer.
6. Construct and generate Frequency Shift Keying (FSK) signal using IC-555 Timer.
7. Construct and test Running LED circuit using IC-555 Timer.
8. Construct water level indicator using IC-555 Timer.
9. Construct continuity tester using IC-555 Timer.

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	V/VI	Mini Project	555 IC related projects
02	VII/VIII	Project work	

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Preparing simple mini projects for domestic/commercial applications.

7.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	ELEKTOR	https://www.elektormagazine.com/magazine/elektor-201405/26447
2	ELECTRONICS FOR YOU	https://www.electronicsforu.com/electronics-projects/555-timer-circuits
3	SERVOMAGAZINE	https://www.servomagazine.com/magazine/article/the-biggest-and-smallest-555-youll-ever-see
4	MAKEZINE	https://makezine.com/tag/555-timer/

8.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40.**

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).
- The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

9.0 Course Delivery Plan

Expt. No.	Aim of the Experiment	% of Portion
1	Construct Astable Multivibrator circuit using IC-555 Timer.	11
2	Construct Mono-stable Multivibrator circuit using IC-555 Timer.	11
3	Construct and test Sequential timer using IC-555.	11
4	Generate Pulse Width Modulator (PWM) signal using IC-555 Timer.	11
5	Construct Burglar Alarm circuit using IC-555 Timer.	11
6	Construct and generate Frequency Shift Keying (FSK) signal using IC-555 Timer.	11
7	Construct and test Running LED circuit using IC-555 Timer.	11
8	Construct water level indicator using IC-555 Timer.	11
9	Construct continuity tester using IC-555 Timer.	11

10.0 QUESTION BANK

1 What is a 555 IC and why it is named 555?
2 What are the features of 555 Timer?
3 What are the components used in functional block diagram of 555 IC ?
4 Distinguish between inverting and non-inverting comparator.
5 What are astable, monostable and bistable multivibrators?
6 Define duty cycle.
7 Why the Reset pin of IC 555 is normally connected to VCC?
8 Why the control voltage pin (pin 5) of 555 timers is connected to ground through a 0.01µf capacitor?
9 What is the temperature range of NE555 IC?
10 What do you meant by ground load?
11 Write the formula to calculate the time period of the astable and monostable multivibrator?
12 What is SR flip flop? Explain its truth table.

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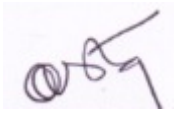			
Prof. K. B. Negalur	**Prof. M. P. Yenagimath**	**HOD**	**Principal**