



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

DEPARTMENT MISSION

To educate students with core knowledge of Electrical and Electronics Engineering by developing problem solving skills, professional skills and social awareness to excel in their career.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's) :

Graduates of the program will be able to

- PEO1:** Possess successful career in Electrical Sciences & apply the knowledge of Mathematics & Engineering fundamentals to analyze & formulate the solution to solve real time problems.
- PEO2:** Excel in Academics, Industry, Entrepreneurship, Administrative Services through lifelong learning.
- PEO3:** Exhibit professional & ethical values, effective communication skills, teamwork, multidisciplinary approach & realize engineering issues in broader social context.

PROGRAM OUTCOMES (PO's) :

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 (PSO's) :**Graduates will be able to**

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	I
2	PSO,s Student Help Desk	II
3	Departmental Resources	III
4	Teaching Faculty Details	IV
5	Institute Academic Calendar	V
6	Department Academic Calendar	VI
7	Scheme of Teaching & Examination III- Semester	VI
Theory – Course Plans , Question Bank & Assignment Questions		
18MAT31-Transform Calculus, Fourier Series and Numerical Techniques-MIII		
18EE32-Electric Circuit Analysis-ECA		
18EE33-Transformers and Generators-T&G		
18EE34-Analog Electronic Circuits-AEC		
18EE35-Digital System Design-DSD		
18EE36-Electrical and Electronic Measurements-EEM		
Laboratory – Course Plan and Viva Questions		
18EEL37-Electrical Machines Laboratory -1-EM Lab-1		
18EEL38-Electronics Laboratory-EC Lab		

1.0**Student Help Desk**



Sl. No	Coordination Work	Contact Person	
		Faculty	Instructor
01	Attestations		
02	Exam forms signature, Overall department administration, Counseling/interaction with Parents/Students.	Dr. B. V. Madiggond	--
03	Research Centre Coordinator		
04	Academic Coordinator, Seminar Coordinator		
05	Online submission of exam form/revaluation form to VTU, IA coordinator, Internship, III Cell Coordinator, SC/ST cell Convener, Examination committee member, Hobby Project Coordinator	Prof. K. B. Negalur	Shri. S. B. Beelur
06	Department Association Coordinator (EESSA)	Prof. H. R. Zinage, Prof. O. B. Heddurshetti	--
07	Dept NBA Coordinator, Project/KSCST Coordinator	Prof. M. P. Yanagimath	--
08	AICTE/VTU,NIRF, News Letter Coordinator, News/Publicity committee member	Prof. S. S. Birade	Shri. R. S. Bardol
09	Dept.TP Cell Coordinator, Robovidya, GATE Coaching, Technical magazine	Prof. P. M. Murari	--
10	Dept. Alumni Coordinator, Library Coordinator	Prof. S. B. Patil	Shri. S. B. Beelur
11	Dept, Website, IEEE/ISTE Coordinator	Prof. V. B. Dhere	--
12	Dept meeting Coordinator, Mentorship Coordinator	Prof. A. U. Neshti	--
13	Electrical Maintenance	Prof. S. D. Hirekodi	--
14	Warden HIT Ladies Hostel, I year Coordinator	Prof. H. R. Zinage	--
15	Chief Alumini Coordinator	Prof. O. B. Heddurshetti	--
16	OBC cell Convener	Prof. P. M. Murari	--
17	Entrepreneurship Cell Coordinator	Prof. V. B. Dhere	--
18	Dispensary	Dr. Arun G. Bullannavar, Contact No. 9449141549	
Class Teacher			
19	3 rd Semester	Prof. S. B. Patil	Shri. S. B. Beelur
20	5 th Semester	Prof. O. B. Heddurshetti	Shri. V. M. Mutalik
21	7 th Semester	Prof. S. D. Hirekodi	Shri. R. S. Bardol

2.0 Departmental Resources

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

2.1 Faculty Position

S.N.	Category	No. in position	Average experience
1	Teaching faculty	12	15.33 Y
2	Technical supporting staff	3	22 Y
3	Helper	2	16 Y

2.2 Major Laboratories



SL. No.	Name of the laboratory	Area in Sq. Mtrs	Amount Invested (Rs)
01	Electronics Lab	71	4,48,518.00
02	Operational Amplifier & Linear Integrated Lab		1,19,042.00
03	Power Electronics Lab	92	7,81,250.00
04	Control Systems Lab		2,12,755.00
05	Power System Simulation Lab	71	11,88,401.00
06	Computer Aided Electrical Drawing Lab		6,50,988.43
07	Microcontroller Lab / Digital Signal Processing Lab	72	5,93,152.00
09	Electrical Machines Lab	200	14,63,682.00
10	Relay & High Voltage Lab	94	11,69,848.00
11	Basic Electrical Engg. Lab	96	38,970.00
	Department , Repair & Maintenance		2,32,933.20
	Total	696	72,54,938.63

3.0 Teaching 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, YH AI	-	26	9343454993
02	Prof. S. B. Patil	Asst. Prof.	M. Tech	Power & Energy System	LMISTE	-	34	8050234360
03	Prof. V. B. Dhere	Asst. Prof.	M. Tech, (Ph. D)	Electronics & Telecommunication	LMISTE, IMPARC	4	22	9886597573
04	Prof. S. D. Hirekodi	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	19	9480849338
05	Prof. H. R. Zinage	Asst. Prof.	M. E.	Power System	LMISTE	-	19	9480849335
06	Prof. M. P. Yanagimath	Asst. Prof.	M. Tech (Ph. D)	VLSI & ES	LMISTE	1	14	9341449466
07	Prof. O. B. Heddurshetti	Asst. Prof.	M. Tech.	Power Electrics	LMISTE	1	12	9448120509
08	Prof. A. U. Neshti	Asst. Prof.	M. Tech.	Digital Electronics	ISTE	-	11	9538223362
09	Prof. P. M. Murari	Asst. Prof.	M. Tech.	PS & PE	LMISTE	-	08	9739733001
10	Prof. S. S. Birade	Asst. Prof.	M. Tech.	VLSI Design & ES	LMISTE	-	07	9945105480
11	Prof. K. B. Neglur	Asst. Prof.	M. Tech.	Industrial Electronics	LMISTE	-	06	9886644507
12	Prof. S. G. Huddar	Asst. Prof.	M. Tech.	Power System	LMISTE	-	06	9742066852



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EEE Dept.

Academic

Course Plan

2019-20
(Odd Sem)

4.0

Institute Academic Calendar



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Institute
File I-11
2019-20 (Odd)
Rev: 0

CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2019-20 (Odd)

Date	Events	Calendar Grid																																										
29-07-2019	Commencement of III/V/VII Sem Classes	August-2019 <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr> <tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td></tr> <tr><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr> </table>	S	M	T	W	T	F	S					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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01-08-2019 to 11-08-2019	Induction Program for I Sem students																																											
15-08-2019	Independence Day & Swachh Bharat Abhiyan	12-Bakrid, 15- Independence day, 26- Last Shravana Monday																																										
05-09-2019	Teachers Day, Mahadasoha	September-2019 <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr> <tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr> <tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr> <tr><td>29</td><td>30</td><td></td><td></td><td></td><td></td><td></td></tr> </table>	S	M	T	W	T	F	S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30					
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16-09-2019	Feed Back-1 on Teaching-Learning																																											
18-09-2019	Display of First Internal Assessment Marks & Submission of Feedback-1 report to office	02- Ganesh Chaturthi, 05- Mahadasoha, 10- Moharam, 28-Mahalaya Amavasye																																										
24-09-2019	EDP Activities/ Green Club activities	October-2019 <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr> <tr><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr> <tr><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td></tr> <tr><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td></td><td></td></tr> </table>	S	M	T	W	T	F	S			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
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02-10-2019	Gandhi Jayanti & Swachh Bharat Abhiyan																																											
11-10-2019	Blood donation camp																																											
21-10-2019 to 23-10-2019	Second Internal Assessment of I/III/V/VII Sem																																											
24-10-2019	Feed Back-2 on Teaching-Learning																																											
28-10-2019	Display of Second Internal Assessment Marks & Submission of Feedback-2 Report to Office	02- Gandhi Jayanti, 07-Ayudha Pooja, 08- Vijayadashami, 13- Valmiki Jayanti, 27- Naraka Chaturdashi, 29- Balipadyami																																										
01-11-2019	Kannada Rajyotsava	November-2019 <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>1</td><td>2</td></tr> <tr><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr> <tr><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr> <tr><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td></tr> <tr><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr> </table>	S	M	T	W	T	F	S						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
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25-11-2019 to 27-11-2019	Lab Internal Assessment of I/III/V/VII Sem																																											
28-11-2019	Display of Third & Final Internal Assessment Marks (I/III/V/VII Sem)																																											
29-11-2019	Last Working Day of I Sem																																											
30-11-2019	Last Working Day of III/V/VII Sem																																											
03-12-2019 to 13-12-2019	Practical Exams of I/III/V/VII Sem	01- Kannada Rajyotsava, 10- Id-e-Milad, 15- Kanakadasa Jayanthi																																										
16-12-2019 to 07-02-2020	Theory Exams of I/III/V/VII Sem																																											

Dr. Shilpa Shrigiri
IQAC Co-ordinator



Dr. S C Kamate
PRINCIPAL

Hirasugar Institute of Technology,
NIDASOSHI 591 236



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EEE Dept.
Academic
Course Plan
2019-20
(Odd Sem)

5.0 Department Academic Calendar

	S J P N Trust's	E&E Engg. Dept
	Hirasugar Institute of Technology, Nidasoshi.	COE
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2019-20 (Odd)

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15-08-2019	Independence Day & Swachh Bharat Abhiyan																																											
23-08-2019	Inauguration of EESSA & Guest Lecture by Alumni/Industry person.																																											
28-08-2019	Submission of First Assignment																																											
05-09-2019	Teachers Day, Mahadasoha																																											
06-09-2019	Indoor Games & Health Checkup Camp																																											
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16-09-2019	Feed Back-1 on Teaching-Learning																																											
18-09-2019	Display of First Internal Assessment Marks & Submission of Feedback-1 report to office																																											
19-09-2019 to 21-09-2019	Three days workshop on MATLAB for staff & students																																											
24-09-2019	EDP Activities/ Green Club activities																																											
30-09-2019	Submission of Third Assignment																																											
02-10-2019	Gandhi Jayanti & Swachh Bharat Abhiyan																																											
04-10-2019	Group Discussion for Final Year Students																																											
11-10-2019	Blood donation camp																																											
18-10-2019	Submission of Fourth Assignment																																											
21-10-2019 to 23-10-2019	Second Internal Assessment of I/III/V/VII Sem																																											
24-10-2019	Feed Back-2 on Teaching-Learning																																											
25-10-2019	Industrial Visit for 3rd & 5th Semester Students.	October-2019 <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr> <tr><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr> <tr><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td></tr> <tr><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td></td><td></td></tr> </table>	S	M	T	W	T	F	S			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
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28-10-2019	Display of Second Internal Assessment Marks & Submission of Feedback-2 Report to Office																																											
01-11-2019	Kannada Rajyotsava																																											
16-11-2019	Submission of Fifth Assignment																																											
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29-11-2019	Last Working Day of I Sem																																											
30-11-2019	Last Working Day of III/V/VII Sem																																											
03-12-2019 to 13-12-2019	Practical Exams of I/III/V/VII Sem	November-2019 <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td>1</td><td>2</td></tr> <tr><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr> <tr><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td></tr> <tr><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td></tr> <tr><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr> </table>	S	M	T	W	T	F	S						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
S	M		T	W	T	F	S																																					
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24	25	26	27	28	29	30																																						
16-12-2019 to 07-02-2020	Theory Exams of I/III/V/VII Sem																																											

Coordinator

H.O.D.

Principal



5.1

Scheme of Teaching & Examination

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT31	Transform Calculus, Fourier Series and Numerical Techniques (Common to all Branches)	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18EE32	Electric Circuit Analysis	EEE	3	2	--	03	40	60	100	4
3	PCC	18EE33	Transformers and Generators	EEE	3	0	--	03	40	60	100	3
4	PCC	18 EE 34	Analog Electronic Circuits	EEE	2	2	--	03	40	60	100	3
5	PCC	18 EE 35	Digital System Design	EEE	3	0	--	03	40	60	100	3
6	PCC	18 EE36	Electrical and Electronic Measurements	EEE	3	0	--	03	40	60	100	3
7	PCC	18 EE L37	Electrical Machines Laboratory -1	EEE	--	2	2	03	40	60	100	2
8	PCC	18 EE L38	Electronics Laboratory	EEE	--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)/	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPC39	Constitution of India, Professional Ethics and Cyber Law									
TOTAL					16	10	04	24	420	480	900	24
					OR	OR		OR	OR	OR		
					17	12		26	360	540		

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	18MATDIP31	Additional Mathematics - I	Mathematics	02	01	--	03	40	60	100	0
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(a) The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B. Tech. programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. 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 F grade. In such a case, the students have to fulfill the requirements during subsequent semester/s to appear for SEE.

(b) These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.



Subject Title	TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES		
Subject Code	18MAT31	IA Marks	40
Number of Lecture Hrs /	04	Exam Marks	60
Total Number of Lecture Hrs	50	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:

Name: Prof. S. S.Thabaj	Designation: Asst. Professor	Experience: 09
No. of times course taught: 06	Specialization: Mathematics	

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z- transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

3.0 Course Outcomes

On completion of this course, students are able to:

	Course Outcome	POs
CO1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.	1,2,3
CO2	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.	1,2,3
CO3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.	1,2,3
CO4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.	1,2,3
CO5	Determine the external of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.	1,2,3
Total Hours of instruction		50



4.0 Course Content

MODULES	RBT Levels	No. Of Hours
MODULE-1 Laplace Transform: Definition and Laplace transforms of elementary functions (statements only). 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. Solution of linear differential equations using Laplace transforms.	L1,L2	10
MODULE-2 Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.	L1, L2	10
MODULE-3 Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems. Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.	L1, L2	10
MODULE-4 Numerical Solutions of Ordinary Differential Equations(ODE's): Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge -Kutta method of fourth order, Milne's and Adam-Bash forth predictor and corrector method (No derivations of formulae)-Problems.	L1, L2	10
MODULE-5 Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae). Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.	L1,L2,L3	10

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	Common to all	Common to all engineering Subjects	Signal and Analysis, Field Theory, Thermodynamics, Fluid Dynamics 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	Special functions are used to wave propagation and scattering, fiber optics, heat conduction in solids, and vibration phenomena.
03	In sampling is the reduction of a to a . A common example is the conversion of a (a continuous signal) to a sequence of samples (a discrete-time signal).



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 2017, 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 N P Bali and Manish Goyal, "A text book of Engineering mathematics" , Laxmi publications, 6th Edition, 2014.
2. B.V.Ramana "Higher Engineering Mathematics" Tata McGraw-Hill, 11th Edition, 2010 .
3. H. K Dass and Er. Rajnish Verma , "Higher Engineering Mathematics" , S. Chand Publishing, 1st Edition, 2011.
4. C. Ray Wylie, Louis C. Barrett "Advanced Engineering Mathematics" , McGraw-Hill Book Co, 6th Edition, 1995
5. Chandrika Prasad and Reena Garg, "Advanced Engineering Mathematics", Khanna Publishing, 2018

Additional Study material & e-Books

1. N.P.Bali & Manish.Goyal, A Text book of Engineering Mathematics, 7th edition, Laxmi Publications.

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\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
3. <http://academicearth.org/>
4. VTU EDUSAT PROGRAMME - 20

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

Internal Assessment: 40 Marks

Theoretical aspects as well as relevant sketches should be drawn neatly.

Scheme of Evaluation for Internal Assessment (40 Marks)

- (a) Internal Assessment test in the same pattern as that of the main examination
(All the three Internal Tests marks considered): 30 Marks.
- (b) Assignments: 10 Marks



SCHEME OF EXAMINATION:

Question paper pattern:

Note: -The SEE question paper will be set for 100 marks and the marks will be proportionately reduced to 60.

- The question paper will have **ten** full questions carrying equal marks.
- Each full question consisting of **20** marks.
- There will be **two** full questions (with a **maximum** of **four** sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer **five** full questions, selecting **one** full question from each module.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
MODULE-1	1	Definition, transforms of elementary functions	20
	2	Properties	
	3	Problems	
	4	Periodic function	
	5	Unit step function	
	6	Problems	
	7	Inverse Laplace Transforms	
	8	Convolution theorem	
	9	Solution of linear differential equations using Laplace Transforms	
	10	Problems	
MODULE-2	11	Introduction, Periodic functions, Dirichlet's conditions	20
	12	Fourier series of periodic functions of period 2π	
	13	Fourier series of periodic functions of arbitrary period $2c$	
	14	Problems	
	15	Fourier series of even functions	
	16	Fourier series of odd functions	
	17	Problems	
	18	Half range Fourier series	
	19	Practical harmonic analysis	
	20	Problems	
MODULE-3	21	Introduction, Infinite Fourier transform	20
	22	Fourier sine transforms	
	23	Fourier cosine transforms	
	24	Inverse transforms	
	25	z-transform-definition	
	26	Standard z-transforms	
	27	Damping rule, Shifting rule	
	28	Initial value and final value theorems (without proof) and problems	
	29	Inverse z-transform	
	30	Applications of z-transforms to solve difference equations	
MODULE-4	31	Numerical solution of ordinary differential equations of first order & first degree	20
	32	Taylor's series method & Problems.	
	33	Modified Euler's method	
	34	Problems	
	35	Runge -Kutta method of fourth order	



	36	Problems	
	37	Milne's predictor and corrector method	
	38	Problems	
	39	Adams-Bashforth predictor and corrector method	
	40	Problems.	
MODULE-5	41	Numerical solution of second order ordinary differential equations	20
	42	Runge -Kutta method	
	43	Problems.	
	44	Milne's method	
	45	Problems.	
	46	Calculus of Variations: Variation of function and Functional, variation problems	
	47	Euler's equation	
	48	Problems	
	49	Geodesics	
	50	Hanging chain, problems	

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	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 questions.	Module 3 of the syllabus	6	Individual Activity.	Book 1, 2 of the reference list. Website of the 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 & Inverse Laplace Transform;

- Find the Laplace Transform of $\sin 2t \sin 3t$. & $\sin^3 2t$.
- Find $L(e^{3t} \sin 2t)$ & $L(e^{4t} \sin 2t \cos t)$.
- Find $L[1-e^t]/t$ & $L[\cos at - \cos bt]/t$
- Using unit step function find LT of $f(t) = \begin{cases} \sin t, & 0 < t < \pi \\ \sin 2t, & \pi < t < 2\pi \\ \sin 3t, & t > 2\pi \end{cases}$
- 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
- Evaluate $L[t^2 u(t-3)]$.
- Find the inverse transform $s+2/s^2-4s+13$.
- Find $L^{-1}[4s+5/(s-1)^2(x+2)]$
- Find $L^{-1}[s/s^4+4a^4]$.
- Find $L^{-1}[s/(s^2+a^2)^2]$.
- Find $L^{-1}[\log(s+1/s-1)]$
- Find $L^{-1}[s/(2s-1)(3s-1)]$.
- Using the Convolution THM obtain the $L^{-1}[s/(s^2+a^2)^2]$.
- Solve the differential equation $d^2y/dx^2-3dy/dx+2y = e^{3t}$ with $y(0)=0=y'(0)$, using LT
- Solve the differential equation $y''+4y'+3y=e^{-t}$, $y(0)=1=y'(0)$. Using LT

Module-2: Fourier series:

- Obtain a Fourier series to represent e^{-ax} from $(-\pi, \pi)$
- Expand $f(x) = x \sin x$, $0 < x < 2$, in a Fourier series.
- For a function $f(x)$ defined by $f(x) = |x|$, $-\pi < x < \pi$, obtain a Fourier series. Deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} = \frac{\pi^2}{8}$
- Find the Fourier series for the function $f(x) = \frac{\pi-x}{2}$ in $(0, 2\pi)$. Hence deduce that $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \dots$
- Find the Fourier series to represent $f(x) = x+x^2$ from $x=-\pi$ to $x=\pi$ and deduce that $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} = \frac{\pi^2}{12}$
- Expand $f(x) = e^{-x}$ as a Fourier series in the interval $(-1, 1)$
- Obtain Fourier series for the function $f(x) = \begin{cases} \pi x, & 0 \leq x \leq 1 \\ \pi(2-x), & 1 \leq x \leq 2 \end{cases}$ and deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \dots$
- Develop $f(x)$ in Fourier series in the interval $(-2, 2)$ if $f(x) = \begin{cases} 0, & -2 < x < 0 \\ 1, & 0 < x < 2 \end{cases}$
- Find the half range cosine series for the function $f(x) = x^2$ in the range $0 \leq x \leq 1$
- Find the complex form of the Fourier series of the periodic function $f(x) = \cos ax$, in $-\pi < x < \pi$.
- 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.

- Obtain the Fourier series for the function $f(x) = \dots$ Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots$

13. Obtain the Fourier expansion of $f(x) = 2x - x^2$ in $0 \leq x \leq 2$

- 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: Fourier Transforms:

1. Find the Fourier transform of

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

2. Find the Fourier transform of the function

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

3. Find the Fourier transform of $\cos ax^2$

4. Find the Fourier sine transform of $e^{-ax/x}$

5. Find the Fourier sine and cosine transform of $f(x) = \begin{cases} 1, & 0 \leq x < a \\ 0, & x \geq a \end{cases}$

6. Find the finite Fourier sine and cosine transform of $f(x) = 2x, 0 < x < 4$.

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 $\int_0^{\infty} \frac{\sin x - x \cos x}{x^3} dx$.

10. Find the Fourier sine transform of $f(x) = \frac{e^{-ax}}{x}, a > 0$.

11. Find the Fourier cosine transform of $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$.

12. Find the Fourier transform of $f(x) = e^{-|x|}$ and Evaluate $\int_0^{\infty} \frac{x \sin mx}{1+x^2} dx$.

13. Find the Fourier transform of $f(x) = e^{-|x|}$ and Evaluate $\int_0^{\infty} \frac{x \sin mx}{1+x^2} dx$.

Z- Transformation:

1. P.T. $z_T(n^2) = \frac{z^2+z}{(z-1)^3}$

2. P.T. $z_T(n^3) = \frac{z^3+4z^2+2}{(z-1)^4}$

3. P.T. $z_T(\cos \theta) = \frac{z(z-\cos \theta)}{z^2-2z\cos \theta+1}$

4. P.T. $z_T(\sin \theta) = \frac{(z \sin \theta)}{z^2-2z\cos \theta+1}$

5. P.T. $z_T(a^n \cos n\theta) = \frac{z(z-a\cos \theta)}{z^2-2az\cos \theta+a^2}$

6. Find the Z-transform of $\cos hn\theta$ & $\sinh n\theta$.

7. Find the Z-transform of $(n+1)^2$

8. Using the inversion integral method find the inverse Z-transform of $\frac{3z}{(z-1)(z-2)}$

9. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ using Z-transform

10. Solve the difference equation $y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = y_1 = 0$ using Z-Transform.

11. Obtain the z-transform of $\cos n\theta$ and $\sin n\theta$

12. Find the Inverse z-transform of $\frac{2z^2+3z}{(z+2)(z-4)}$.

13. If $\bar{u}(z) = \frac{2z^2+3z+12}{(z-1)^4}$, find the value of u_0, u_1, u_2, u_3 .

14. Solve the difference equation $u_{n+2} + 6u_{n+1} + 9u_n = 2^n, u_0 = u_1 = 0$.

MODULE-4: Numerical Methods



1. Solve $\frac{dy}{dx} = x^2y - 1$ with $y(0)=1$ using Taylor's series method and find $y(0.1)$ consider upto 4th degree terms.
2. Use Runge Kutta fourth order method to solve $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$ with $y(0)=1$ and find y for $x=0.2$ and 0.4 take $h=0.2$
3. Given $\frac{dy}{dx} = xy + y^2$, $y(0)=1$, $y(0.1)=1.1169$, $y(0.2)=1.2773$, $y(0.3)=1.5049$ find $y(0.4)$ accurate upto three decimal places using Milne's predictour corrector method.
4. Applying R-K method to find an approximate value of y for $x=0.2$ in steps of 0.1 of $\frac{dy}{dx} = x + y^2$ given that $y=1$ when $x=0$.
5. Given $\frac{dy}{dx} = x^2(1 + y)$ & $y(1)=1$, $y(1.1)=1.233$, $y(1.2) = 1.548$, $y(1.3) = 1.979$. Evaluate $y(1.4)$ by Adams Bash Fourth method
6. Employ Taylor's series method to find an approximate solution correct to fourth decimal places for the following initial value problem at $x=0.1$ & 0.2 $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$.
7. Using Milne's predictour corrector method find y where $x=0.8$ given $\frac{dy}{dx} = x - y^2$, $y(0)=0$, $y(0.2)=0.02$, $y(0.4)=0.0795$, $y(0.6)=0.1762$. Applying corrector formula twice.
8. Employ R-K method of 4th order to solve the equation $\frac{dy}{dx} = 3x + y/2$, $y(0)=1$ at $x=0.2$ taking step length $h=0.1$
9. Solve the differential equation $\frac{dy}{dx} = x^2 + y^2$ given $y(0)=1$ to find the value of $y(0.1)$ by using Taylor's series method of order.
10. Using modified Euler's method, solve the equation $\frac{dy}{dx} = \frac{1}{x+y}$, $y(0)=1$ in steps of 0.5 at $x = 1$
11. Using Adams Bash fourth predictor correct method find y when $x=0.8$ given $\frac{dy}{dx} = x - y^2$, $y(0)=0$, $y(0.2)=0.02$, $y(0.4)=0.0795$, $y(0.6)=0.1762$. Apply correct formula twice.
12. Using Taylor's series method to find y at the point $x=0.1$ & $x=0.2$ given that $\frac{dy}{dx} = x^2 + y^2$, $y(0)=1$
13. From the data given below find y at $x=1.4$ using Milne's predictour corrector method $y' = x^2 + y/2$


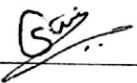


x	1	1.1	1.2	1.3
y	2	2.2156	2.4649	2.7514

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 Catenary is the curve which when rotated about a line generates a surface of minimum area.



11. Find the extremal of the functional $\int_0^\pi (y'^2 - y^2 + 4y \cos x) dx$; $y(0) = 0 = y(\pi)$
12. Solve the variational 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.

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



Subject Title	ELECTRIC CIRCUIT ANALYSIS-Core		
Subject Code	18EE32	CIE Marks	40
Number of Lecture Hrs / Week(L:T:P)	3:2:0	SEE Marks	60
Total Number of Lecture Hrs	50	Exam Hours	03
Credits-04			

FACULTY DETAILS:		
Name: Prof. Pramod Murari	Designation: Asst. Professor	Experience: 8.5 Years
No. of times course taught: 03		Specialization: Power System & Power Electronics

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
02	First Year	I/II	BEE

2.0 Course Objectives

- To familiarize the basic laws, source transformations theorems and the methods of analyzing electrical circuits.
- To explain the use of network theorems and the concept of resonance.
- To familiarize the analysis of three-phase circuits, two port networks and networks with non sinusoidal inputs.
- To explain the importance of initial conditions, their evaluation and transient analysis of R-L and R-C circuits.
- 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	Cognitive Level	Pos
C202.1	Understand 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.	U	1-3
C202.2	Solve complex electric circuits using network theorems.	U	1-3
C202.3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.	U	1-3
C202.4	Synthesize typical waveforms using Laplace transformation.	U	1-3
C202.5	Solve unbalanced three phase systems and also evaluate the performance of two port networks.	U	1-3
Total Hours		50	

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. **10 Hours**

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing.



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. **10 Hours.**

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing.

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 ($t=0$ & $t=\infty$), Evaluation of initial conditions. **10 Hours.**

Revised Bloom's Taxonomy Level L2 – Understanding, L3 – Applying, L4 – Analysing, L5-Evaluating

Module-4

Laplace Transformation: Laplace transformation (LT), LT of Impulse, Step, Ramp, Sinusoidal signals and shifted functions. Waveform synthesis. Initial and Final value theorems. **10Hours.**

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing.

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. **10 Hours.**

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VI	Power system analysis and stability	Module 2 and Module 4
01	VII	Transmission and Distribution	Module 3

6.0 Relevance to Real World

Sl.No	Real World Mapping
01	Electrical and Electronic circuits and components.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Practical	Finding magnitudes of currents & voltages of a simple electric networks through pspice 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
5. Basic Electrical Engineering, V.K.Mehta, Rohit Mehta, S Chand publisher, 6 th edition 2015
Additional Study material & e-Books
1. Network theory by Ganesh Rao
2. Network analysis by P M Chandrashekaraiiah
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.doccity.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 theory	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 (60:40) Pattern

Assignment marks: 10 marks.

Question paper pattern IA exam:

Answer two full questions Q1 or Q2 and Q3 or Q4 (15marks each). Total 30 Marks.

Question paper pattern Main exam:

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

12.0

Course Delivery Plan

Module	Lecture No.	Content of Lecture	% of Portion
I	1.	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	
	9.	Numerical	
	10.	Numerical	
II	11.	Network Theorems: Super Position Theorem,	20
	12.	Reciprocity theorem,	
	13.	Thevenin's Theorem,	
	14.	Norton's Theorem.	
	15.	Analysis of networks, with and without dependent ac and dc sources.	
	16.	Numerical	
	17.	Numerical	
	18.	Numerical	
	19.	Numerical	
	20.	Numerical	



III	21.	Resonant Circuits: Analysis of simple series RLC circuits under resonances.	20
	22.	Analysis of simple parallel RLC circuits under resonances.	
	23.	Problems on Resonant frequency, Bandwidth and Quality factor at resonance	
	24.	Transient Analysis: Transient analysis of RL and RC circuits under dc and ac excitations:	
	25.	Behaviour of circuit elements under switching action.	
	26.	Evaluation of initial conditions.	
	27.	Numerical	
	28.	Numerical	
	29.	Numerical	
	30.	Numerical	
IV	31.	Laplace Transformation: Laplace transformation (LT), LT of Impulse function.	20
	32.	LT of Step, Ramp functions	
	33.	LT of Sinusoidal signals and shifted functions.	
	34.	Waveform synthesis.	
	35.	Initial and Final value theorems.	
	36.	Numerical	
	37.	Numerical	
	38.	Numerical	
	39.	Numerical	
	40.	Numerical	
V	41.	Unbalanced Three phase systems: Analysis of three phase systems.	20
	42.	Calculation of real and reactive powers.	
	43.	Two Port networks: Definition, Open circuit impedance,	
	44.	Short circuit admittance and Transmission parameters.	
	45.	And their evaluation for simple circuits.	
	46.	Numerical	
	47.	Numerical	
	48.	Numerical	
	49.	Numerical	
	50.	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: University Questions on basic concepts	Students understand basic concepts in circuit theory & get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity. Written solution expected.	Book 1,2 of the text book list. & additional study material 1,2
2	Assignment 2: University Questions on Network theorems.	Students understand various network theorems get practice to solve university questions.	Module 2 of the syllabus	4	Individual Activity. Written solution expected.	Book 1,2 of the text book list. & additional study material 1,2



3	Assignment 3: University Questions on Resonant circuits and Transient analysis.	Students understand resonant circuits and Transient behavior of first and second order differential equations & get practice to solve university questions.	Module 3 of the syllabus	6	Individual Activity. Written solution expected.	Book 1,2 of the text book list. & additional study material 1,2
4	Assignment 4: University Questions on Laplace transformation	Students Laplace transformation of various signals & get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity. Written solution expected.	Book 1,2 of the text book list. & additional study material 1,2
5	Assignment 5: University Questions on Unbalanced three phase power system, two port networks and complex wave analysis.	Students study Unbalanced three phase power system and two port network analysis & get practice to solve university questions.	Module 5 of the syllabus	10	Individual Activity. Written solution expected.	Book 1,2 of the text book list. & additional study material 1,2

14.0 Assignment Questions

Assignment No	Questions	Marks
I	Q1. Determine the resistance between the terminals M and N of the network in fig 2 Q2. In the network shown in fig.4 find the PVS between A and B Q3. Use mesh analysis to find the voltage across 15A source in fig. 6 Q4. Use node analysis to find the current through 4 ohm resistor in fig8	5marks each
II	Q1. Find the current through 3 ohm resistor using superposition theorem in fig1 Q2. Find the current I_x in $j2$ ohm impedance and verify reciprocity theorem in fig 3 Q3. Find thevenin equivalent of fig10 Q4. Find Norton Equivalent of fig12	5marks each
III	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, $R=100\text{ohm}$, $L=1\text{H}$ and $I=2\text{A}$ Q2. In the circuit in fig4 the switch is opened at $t=0$ find the values of V , dV/dt and d^2V/dt^2 at $t=0+$ 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 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.	5marks each
IV	Q1. State and prove initial value and final value theorem. Q2. State and prove convolution theorem Q3. Define and obtain the Laplace transform of i) UNIT impulse function ii) UNIT ramp function iii) UNIT step function Q4. Obtain the Laplace transform of full wave rectified sine wave of amplitude 1 and period π sec.	5marks each
V	Q1. Two 2port networks are connected in cascade obtain T-parameters of the interconnected network in terms of T parameters of the individual networks. Q2. A two port network in terms of Z-parameters is said to be symmetric if $Z_{11}=Z_{22}$ and reciprocal if $Z_{12}=Z_{21}$. Obtain the corresponding conditions in terms of i) h Parameters ii) T-parameters using the relationship between different two-port parameters. Q3. Obtain ABCD parameters in terms of z-parameters and show that $AD-BC = 1$ Q4. Explain i) Z-parameters ii) Y-Parameters iii) Transmission parameters.	5marks each



15.0

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) Star 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 V_x 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 V_1, V_2, V_3, V_4 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 $(2+j3)\Omega$ 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 Thevenin's equivalent circuit at terminals a-b of the network shown in fig.4.2 and hence obtain the current through $R=10\Omega$ 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 V_x and verify reciprocity theorem in fig 4
12. Using thevenin 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) ω_c at which maximum voltage occurs across C ii) ω_L at which maximum voltage occurs across L & show that $\omega_L > \omega_c$
5. Derive the expression for the resonant frequency for a parallel resonance when R_L connected parallel to R_c . 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 $R\Omega$ 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 $R = 10\Omega, L = 0.1H$ & $C = 50\mu F$ has an applied voltage $V = 50\angle 0^\circ$ 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 $Q=f_0/BW$
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 resonance 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 $t=0^+$
23. In the network shown in fig 6.2 the capacitor C1 is charged to voltage $V_0 = 1000v$ and the switch K is opened at $t=0$. solve for d^2i_1/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 π sec.
6. Determine the current expression $V_o(t)$ 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 $R=4\Omega$, $L=2H$, when each of the following driving force voltages are applied
8. i) UNIT ramp voltage $r(t-5)$ ii) UNIT impulse voltage $\delta(t-5)$
9. iii) UNIT sep voltage $U(t-5)$ Assume zero initial conditions.
10. For the circuit shown in fig.7.2 Find $v_o(t)$ using convolution theorem.
11. A pulse voltage of magnitude 5 and duration 1 sec is applied to a series RC circuit having $R=5\Omega$, $C=0.2f$. Calculate the current $i(t)$ 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-parameters is said to be symmetric if $Z_{11}=Z_{22}$ and reciprocal if $Z_{12}=Z_{21}$. 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.
$$\begin{matrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{matrix} = \begin{matrix} 5 & 2 \\ 3 & 6 \end{matrix}$$
- 13.
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)

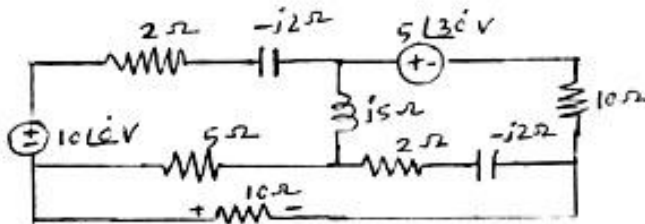


Fig 1.1

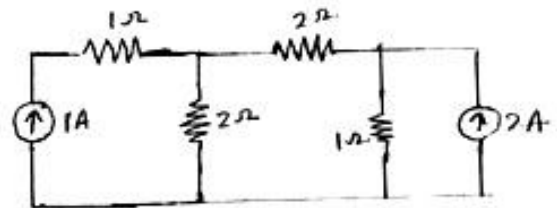


Fig 1.2

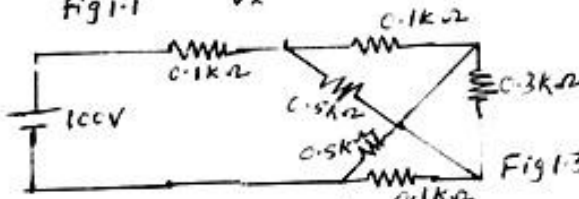


Fig 1.3

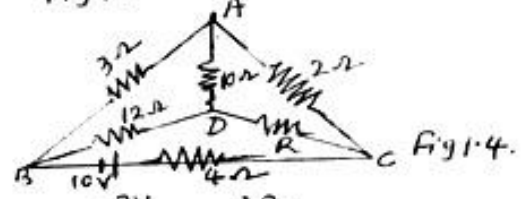


Fig 1.4

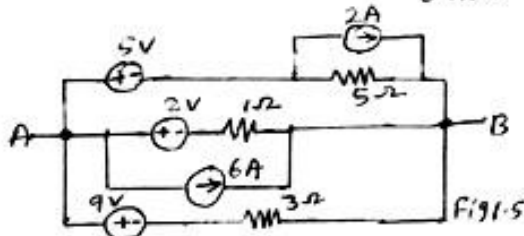


Fig 1.5

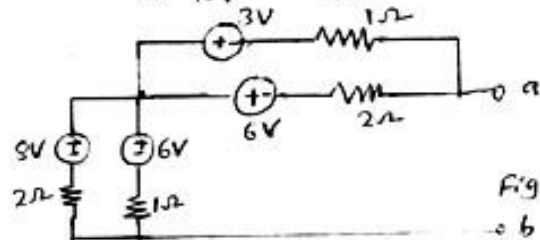


Fig 1.6

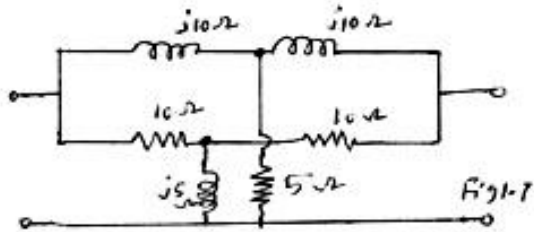


Fig 1.7

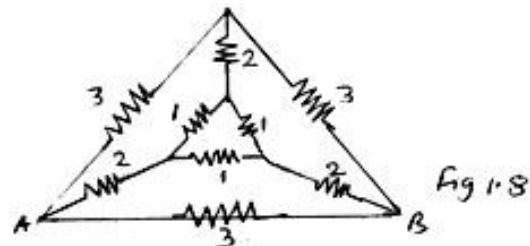


Fig 1.8

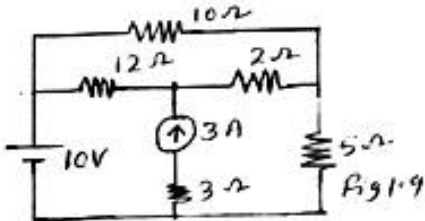


Fig 1.9

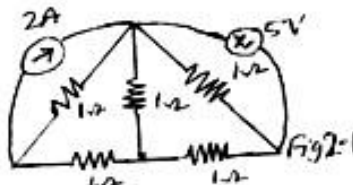


Fig 2.1

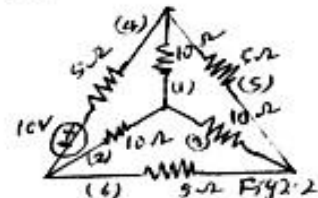


Fig 2.2

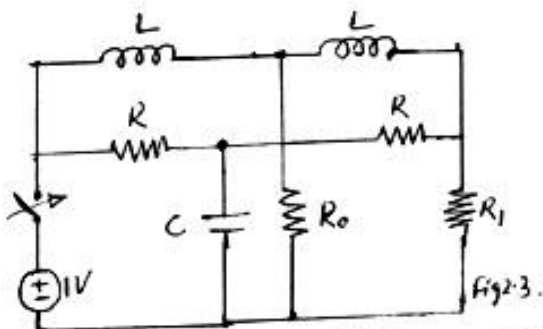


Fig 2.3

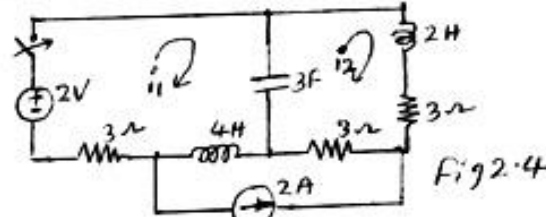


Fig 2.4

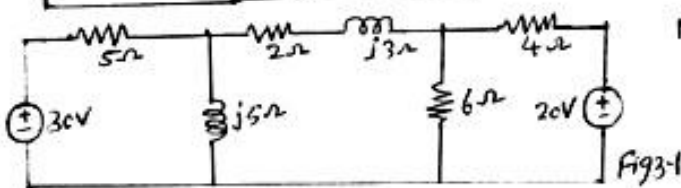


Fig 3.1

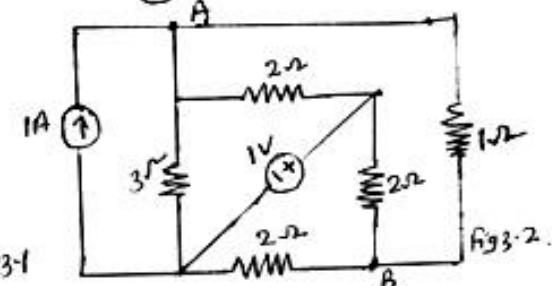
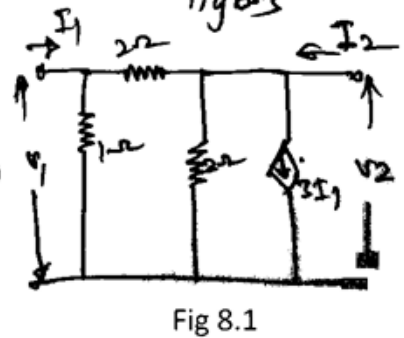
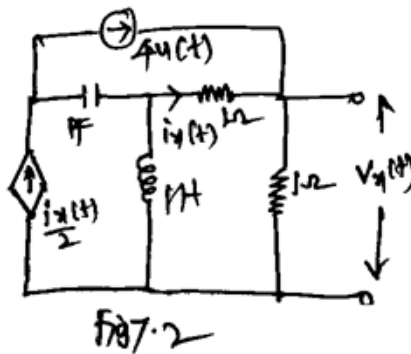
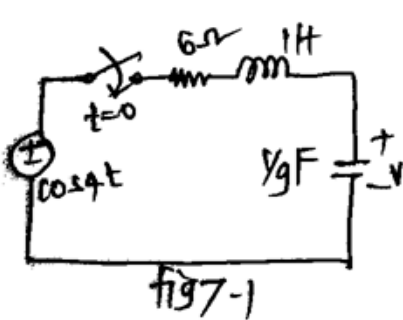
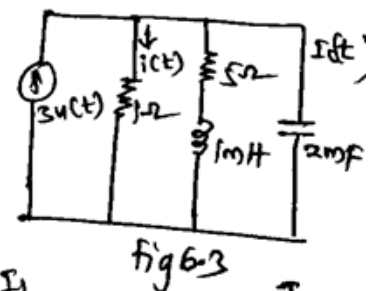
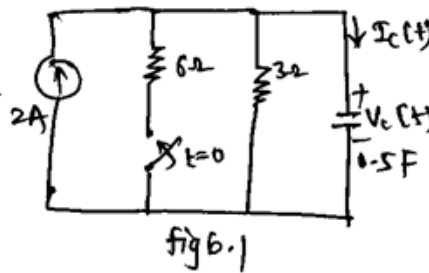
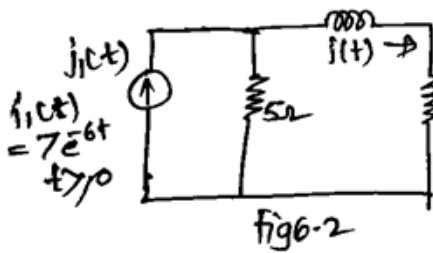
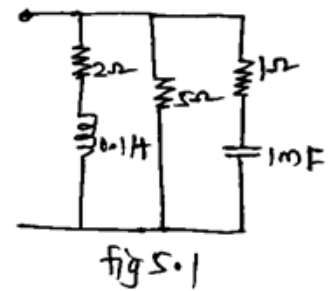
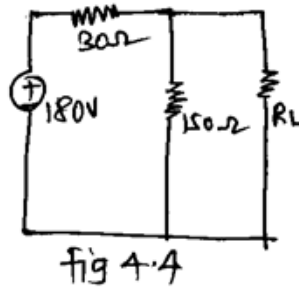
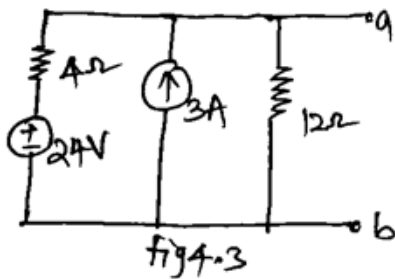
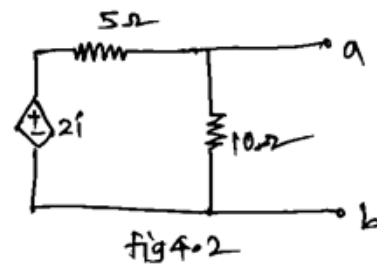
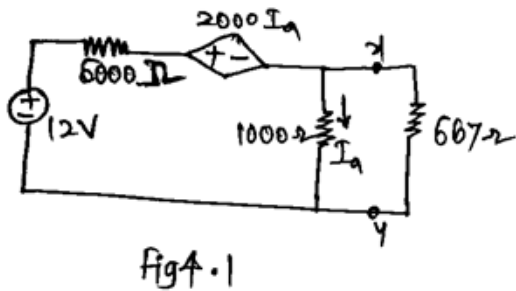
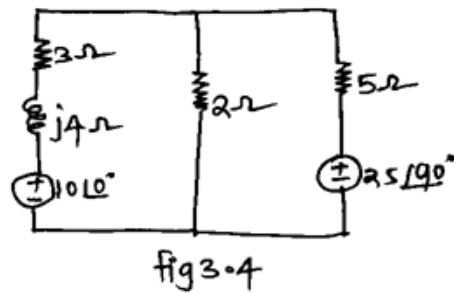
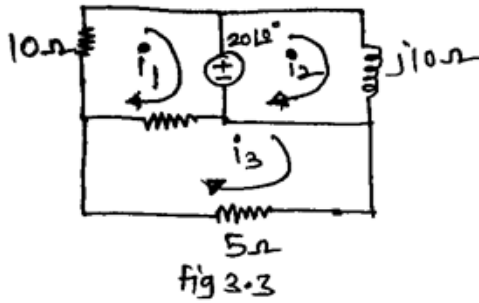


Fig 3.2



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





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

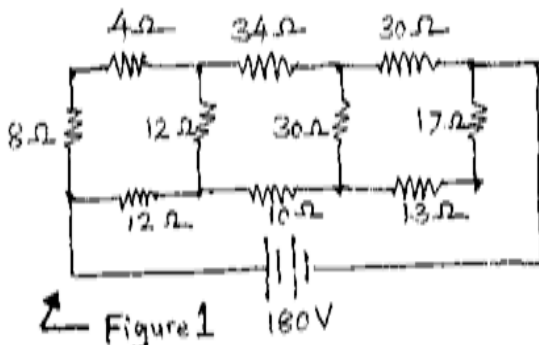


Figure 1 180V

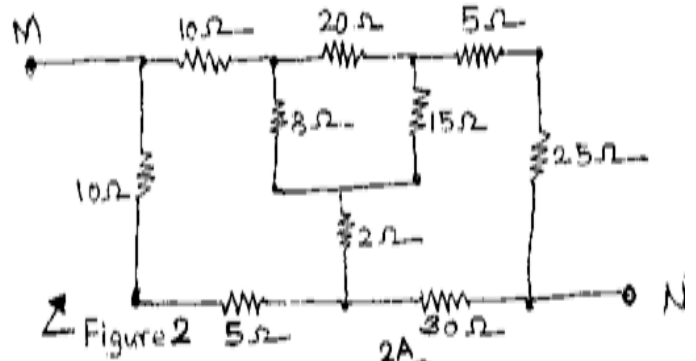


Figure 2

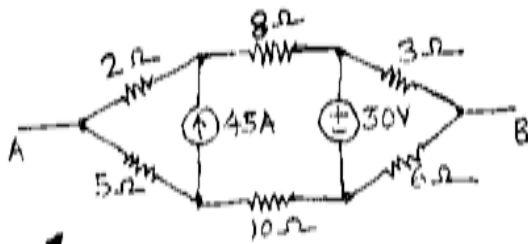


Figure 3

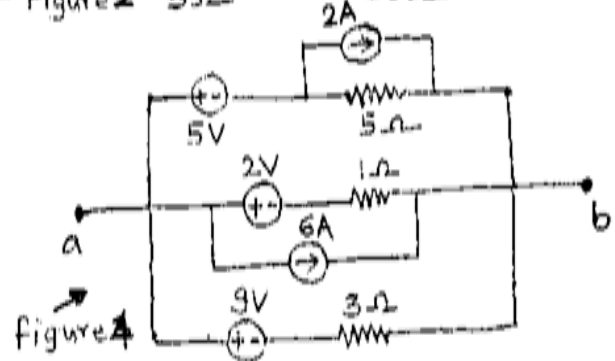


Figure 4

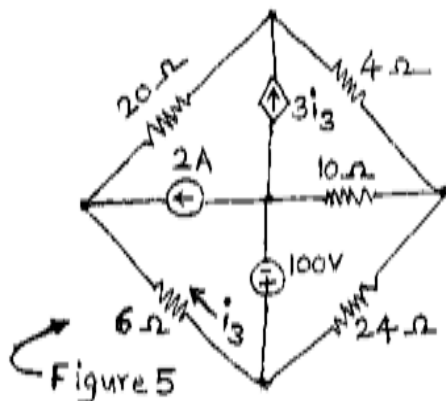


Figure 5

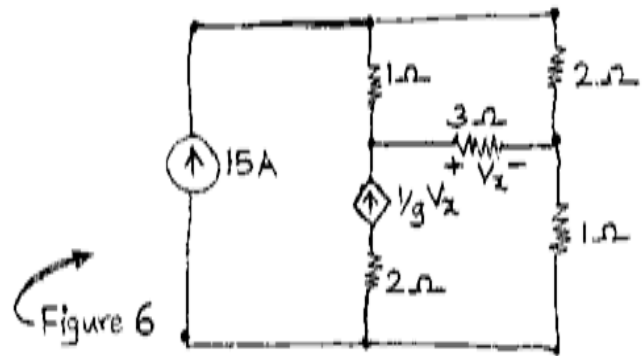


Figure 6

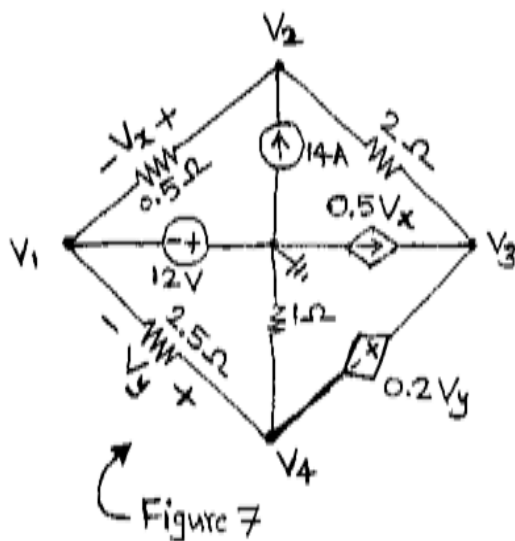


Figure 7

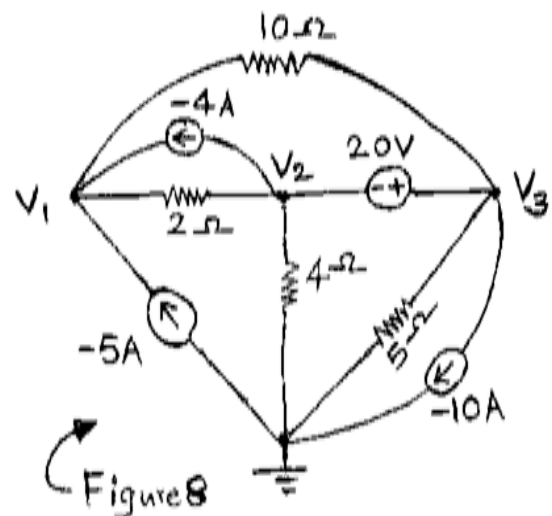


Figure 8



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

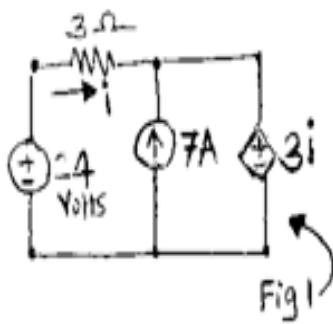


Fig 1

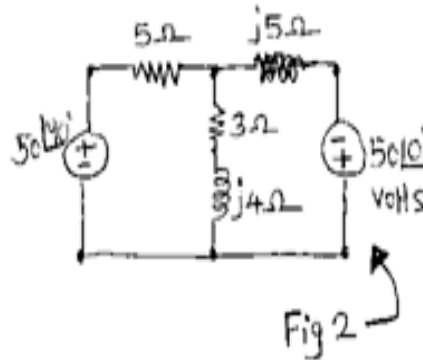


Fig 2

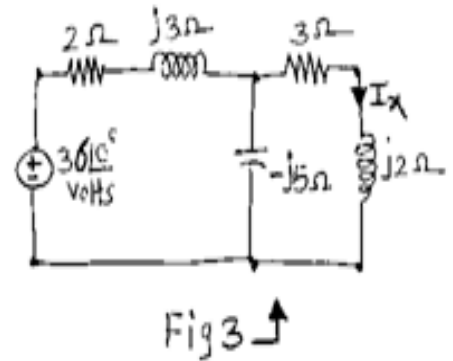


Fig 3

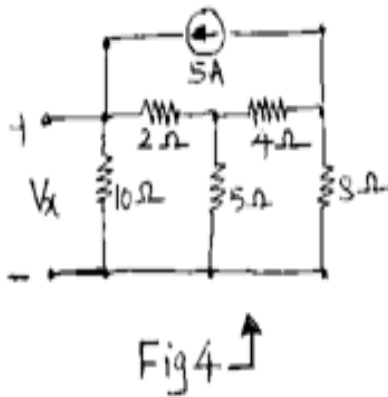


Fig 4

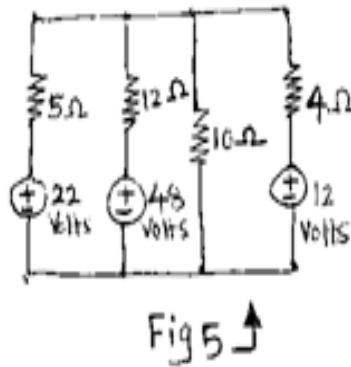


Fig 5

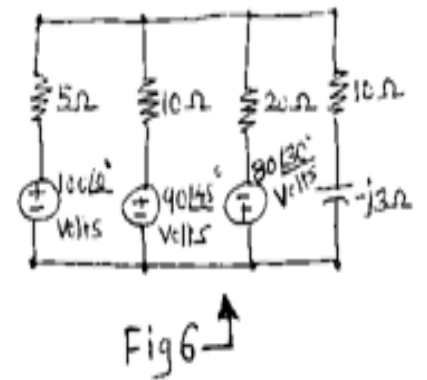


Fig 6

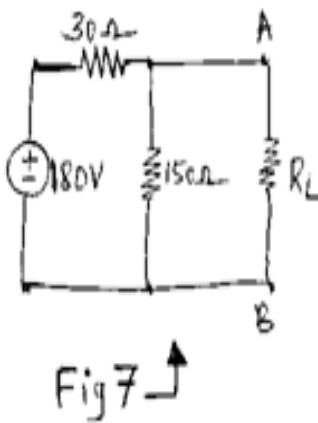


Fig 7

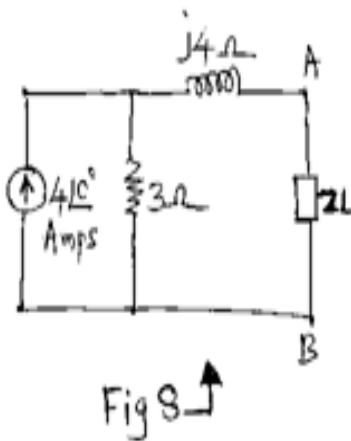


Fig 8

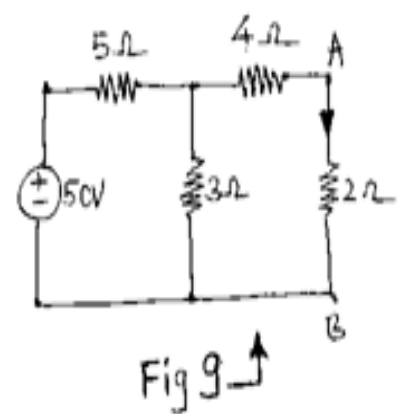


Fig 9

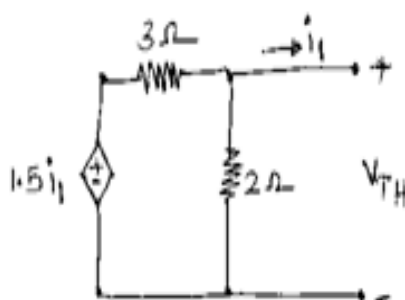


Fig 10

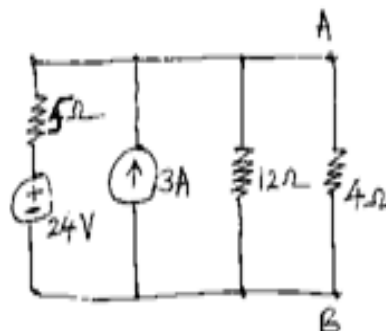


Fig 11

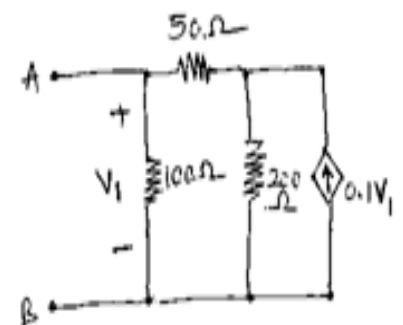
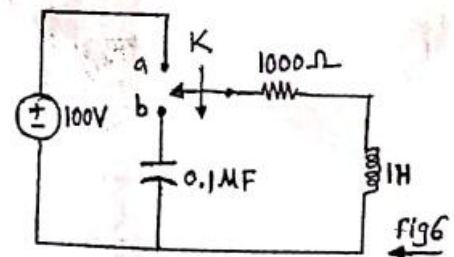
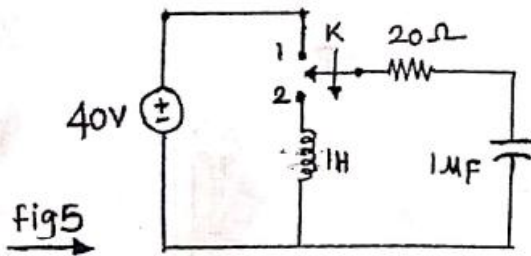
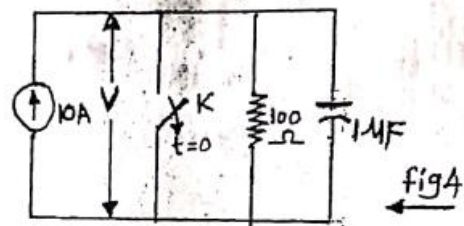
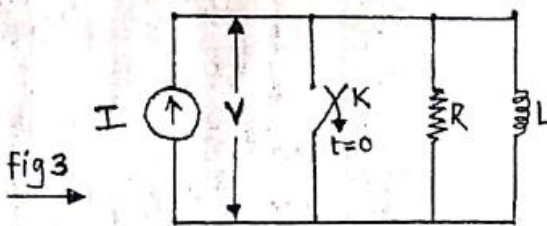
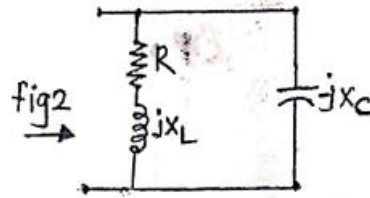
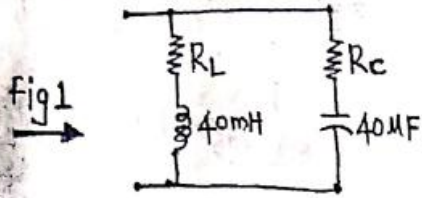


Fig 12



Sample networks on resonance, transient analysis



16.0 University Result

Examination	% Passing
Jan 2019	50

Prepared by	Checked by		
Prof. Pramod Murari	Prof. O B Heddurshetti	HOD	Principal



Subject Title	TRANSFORMER AND GENERATOR		
Subject Code	18EE33	IA Marks {CIV}	40
Number of Lecture Hrs / Week	05L	Exam Marks{SEE}	60
Total Number of Lecture Hrs	65	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Prof. S B PATIL	Designation: Asst.Professor	Experience: 33 years 6 Months
No. of times course taught: 02	Specialization: Power and Energy System	

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 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	Cognitive Level	Pos
CO203.1	Understand the construction and operation of 1-phase, 3-Phase transformers and Autotransformer.	U	PO(1,2,3,4)
CO203.2	Analyze the performance of transformers by polarity test, Sumpner's Test, phase conversion, 3-phase connection, and parallel operation.	U	PO(1,2,3,4)
CO203.3	Understand the construction and working of AC and DC Generators.	U	PO(1,2,3,4)
CO203.4	Analyze the performance of the AC Generators on infinite bus and parallel operation.	U	PO(1,2,3,4)
CO203.5	Determine the regulation of AC Generator by Slip test, EMF, MMF, and ZPF Methods.		
Total Hours of instruction			50

4.0 Course Content

Module-1

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.

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.

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.

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

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 X_d & X_q – 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.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	IV	Electric motor	Principles of machine
	VII	Testing & commissioning of power system apparatus.	Transformer, and Alternator
02	VII&VIII	Seminar and project	Knowledge of machine

6.0 Relevance to Real World

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

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 .Included animation slides 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 4 th edition, 2011
2 Principals of Electrical Machines V.K Mehta, Rohit Mehta S Chand 2 nd edition, 2009
Reference Books
1 Electric Machines Mulukuntla S.Sarma, at el Cengage 1st Edition, 2009
2 Electrical Machines, Drives and Power systems Theodore Wildi Pearson 6th Edition, 2014
3 Electric Machines Ashfaq Hussain Dhanpat Rai & Co
Additional Study material & e-Books
1.Electric machines by Godse & Bakshi



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.electrical4u.com/dc generator
8)	www.electrical4u.com/alternator
9)	www.electrical4u.com/alternator
10)	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

Question paper pattern:

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

Internal Assessment: 40 Marks

Scheme of Evaluation for Internal Assessment (40 Marks)

- There are four questions each of 15 marks with option student has two answers any two full question.

12.0

Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
	1.	Single phase Transformers: operation of practical transformer under no – load and on – load with phasor diagrams.	15.38%
	2.	Equivalent circuit,	
	3.	Open circuit and Short circuit tests, calculation of equivalent circuit parameters.	
	4.	Predetermination of efficiency commercial and all-day.	
	5.	Voltage regulation and its significance.	
	6.	Three-phase Transformers: Introduction, Constructional features of three-phase transformers.	
	7.	Choice between single unit three-phase transformer and a bank of three single-phase transformers.	
	8.	Transformer connection for three phase operation – star/star, delta/delta, star/delta, zigzag/star and V/V, choice of connection.	



1	9.	Phase conversion – Scott connection for three-phase to two-phase conversion	
	10.	Labelling of three-phase transformer terminals, vector groups.	
2	11.	Polarity and sumpner test.	15.38%
	12.	Parallel Operation of Transformers: Necessity of Parallel operation, conditions for parallel operation – Single phase and three phase.	
	13.	Load sharing in case of similar	
	14.	Load sharing in case of dissimilar transformers	
	15.	Problems on load sharing	
	16.	Auto transformers and Tap changing transformers: Introduction to auto transformer – copper economy	
	17.	Auto transformer copper economy	
	18.	Equivalent circuit.	
	19.	Tap changing – off circuit	
	20.	Tap changing – on load.	
3	21.	Transformers (continuation): Tertiary winding Transformers: Necessity of tertiary winding.	19.230%
	22.	Equivalent circuit and voltage regulation.	
	23.	Tertiary winding in star/star transformers & Rating of tertiary winding.	
	24.	Direct current Generator Armature reaction.	
	25.	Commutation	
	26.	Problems	
	27.	Synchronous generators- Review of construction and operation of salient & non-salient pole synchronous generators (No question shall be set from the review portion).	
	28.	Armature windings, winding factors, emf equation.	
	29.	Harmonics – causes, reduction and elimination	
	30.	Armature reaction, Synchronous reactance, Equivalent circuit	
4	31.	Synchronous generators : Generator load characteristic.	9.615%
	32.	Voltage regulation, excitation control for constant terminal voltage.	
	33.	Generator input and output.	
	34.	Parallel operation of generators and load sharing.	
	35.	Synchronous generator on infinite busbars – General load diagram.	
	36.	Electrical load diagram, mechanical load diagram.	
	37.	O – curves and V – curves. Power angle characteristic and synchronizing power.	
	38.	Effects of saliency, two-reaction theory.	
5	39.	Synchronous generators (continuation): Open circuit and short circuit characteristics.	15.38%
	40.	Assessment of reactance- short circuit ratio	
	41.	Synchronous reactance, adjusted synchronous reactance and Potier reactance.	
	42.	Voltage regulation by EMF method.	
	43.	Voltage regulation by MMF method.	
	44.	Voltage regulation by ZPF method.	
	45.	Voltage regulation by ASA method.	
	46.	Performance of synchronous generators: Capability curve for large turbo generators and salient pole generators.	
	47.	Starting, synchronizing and control.	
	48.	Hunting and dampers.	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
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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 of the syllabus	2	Individual Printed solution expected.	Activity.	Book 2, 3 of the reference list. Website of the Reference list
2	Assignment 2: University Questions on autotransformer	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 of the syllabus	4	Individual Printed solution expected.	Activity.	Book 2, 3 of the reference list. Website of the Reference list
3	Assignment 3: University Questions on dc generator	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	6	Individual Printed solution expected.	Activity.	Book 2, 3 of the reference list. Website of the Reference list
4	Assignment 4: University Questions on synchronous generator	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Printed solution expected.	Activity.	Book 2, 3 of the reference list. Website of the Reference list
5	Assignment 5: University Questions on synchronous generator	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	10	Individual Printed solution expected.	Activity.	Book 2, 3 of the reference list. Website of the Reference list

14.0 Assignment Questions

Assignment No	Questions	Marks
1	1. Derive the EMF equation of a transformer.	5marks
	2. Explain in brief Starting from fundamental develop the exact equivalent circuit and Approximate equivalent circuit of a single phase transformer referred to primary?	5marks
	3. Draw the phasor diagrams of single phase transformer with unity pf and lagging pf loads.	5marks
	4. Draw the phasor diagrams of single phase transformer with unity pf and lagging pf loads.	5marks
2	1. What is an autotransformer? Derive an expression for the saving of copper when an autotransformer is used? Mention its applications?	5marks
	2. What is an autotransformer? Discuss merits and demerits of autotransformer?	5marks
	3. Discuss the equivalent circuit, three phase autotransformer connection and voltage Regulation.	5marks
	4. Discuss the Voltage regulation by tap changing – off circuit and on load.	5marks
3	1. With the neat diagram explain the process of commutation in the d.c machine.	5marks
	2. Explain the methods of improving the commutation.	5marks
	3. Explain what is meant by critical field resistance in a d.c shunt generator and Explain the method of determining it.	5marks
	4. Explain why interpoles and compensating winding are used in d.c machine.	5marks
4	1. Obtain expression for power angle equation of salient Pole synchronous generator Connected to infinite bus bar. Sketch this characteristic this characteristic and comment on its shape.	5 Marks
	2. With neat circuit diagram, explain how an alternator is synchronized with bus bars.	5 Marks
	3. Discuss the Electrical load diagram & mechanical load diagram.	5marks
	4. Discuss the O – curves and V – curves of alternator.	5 marks
5	1. Why is alternator terminal voltage, when loading is not equal to the no load voltage.	5Marks
	2. Discuss Capability curve for large turbo generators and salient pole generators.	5 Marks
	3. Discuss the Starting, synchronizing and control.	5 Marks
	4. Discuss the Hunting and damper winding.	5 Marks

15.0 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 Describe the necessity & Explain the Necessary conditions for parallel operation of single phase transformers and then the three phase.
- 2 Discuss the Load sharing in case of similar and dissimilar transformers.
- 3 What is an autotransformer? Derive an expression for the saving of copper when an autotransformer is used? Mention its applications?
- 4 What is an autotransformer? Discuss merits and demerits of autotransformer?
- 5 Discuss the equivalent circuit, three phase autotransformer connection and voltage regulation.
- 6 Discuss the Voltage regulation by tap changing – off circuit and on load.
- 7 Discuss the Necessity of tertiary winding, equivalent circuit and voltage regulation.
- 8 Discuss the tertiary winding in star/star transformers & rating of tertiary winding.

Module 3

1. Explain the causes & effects of harmonics generated by transformers.
2. Explain the Current inrush in transformers & generation of noise in transformer.
3. Discuss the Objects of testing transformers & polarity test.
4. Explain With neat diagram explain in detail Sumpner's test for determining the efficiency and voltage regulation of transformer. Mention its advantages and disadvantages.
5. With neat diagram explain the phenomenon of armature reaction in d.c machine.
6. Develop an expression for demagnetizing and cross magnetizing armature ampere turns in a d.c generator.
7. With the neat diagram explain the process of commutation in the d.c machine.
8. Explain the methods of improving the commutation.
9. Explain what is meant by critical field resistance in a d.c shunt generator and explain the method of determining it.
10. Explain why interpoles and compensating winding are used in d.c machine.
11. List the advantage of stationary armature in synchronous machine.
12. Explain the essential difference between cylindrical and salient pole rotors used in large alternators.
13. List the advantage of chording of armature coils in synchronous machine. Derive the expression for pitch factor.
14. Define the breadth factor. Derive expression for it.
15. Derive an equation for emf induced in an alternator.
16. Write a short note on armature reaction in alternator.
17. Discuss the various measures adopted in a practice to make the waveform of large alternators to be closely sinusoidal.
18. Explain the Harmonics – causes, reduction and elimination in an alternator.
19. Discuss the Synchronous reactance & Equivalent circuit in an alternator.

Module 4

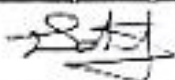
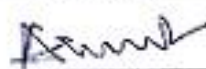


1. Discuss the Synchronous generator load characteristics.
2. An alternator is supplying constant load. With suitable vector diagram and explain the effect of variation on excitation on armature current and power factor.



3. Explain how two or more alternators are made to share the load in proportion to rating.
4. List the conditions to be fulfilled to connect two alternators in parallel.
5. With the usual notations derive an expression for synchronizing power and torque when two alternators are connected in parallel.
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. Derive an expression for mechanical power developed by salient pole synchronous motor Hence Explain what is meant by reluctance torque.
8. 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.
9. With neat circuit diagram, explain how an alternator is synchronized with bus bars.
10. Discuss the Electrical load diagram & mechanical load diagram.
11. Discuss the O – curves and V – curves of alternator.
12. With neat circuit diagram explain the slip test salient Pole synchronous machine and indicate X_d and X_q can be determined from the test.

Module 5

1. Define " Regulation of alternator ". Explain potier reactance method of finding the Regulation of alternator.
2. Define " Regulation of alternator ". Explain ASA method of finding the Regulation of alternator. And compare with other known method.
3. Define " Regulation of alternator ". Explain MMF or ampere turn's method of finding the Regulation of alternator.
4. Describe synchronous impedance method to determine the regulation of alternator for lagging and leading power factor.
5. Why is alternator terminal voltage, when loading is not equal to the no load voltage.
6. Discuss Capability curve for large turbo generators and salient pole generators.
7. Discuss the Starting, synchronizing and control.
8. Discuss the Hunting and damper winding.

Prepared by	Checked by		
			
Prof. S B Patil	Prof. Amit Neshit	HOD	Principal



Subject Title	ANALOG ELECTRONIC CIRCUITS (Core Course)		
Subject Code	18EE34	CIE Marks	40
Number of Lecture Hrs / Week	2:2:0	SEE Marks	60
Total Number of Lecture Hrs	50	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Prof. Sagar S B	Designation: Asst. Professor	Experience: 07 Years
No. of times course taught: 06	Specialization: VLSI Design & Embedded Systems	

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

1. Provide the knowledge for the analysis of diode and transistor circuits.
2. Develop skills to design the electronic circuits like amplifiers and oscillators.

3.0 Course Outcomes

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

	Course Outcome	POs
CO204.1	Obtain the output characteristics of clipper and clamper circuits.	1,2,5,8
CO204.2	Design and compare biasing circuits for transistor amplifiers & explain the transistor switching.	1,2,5,8
CO204.3	Explain the concept of feedback, its types and design of feedback circuits.	1,2,5,8
CO204.4	Design and analyze the power amplifier circuits and oscillators for different frequencies.	1,2,5,8
CO204.5	Design and analysis of FET and MOSFET amplifiers.	1,2,5,8
Total Hours of instruction		50

4.0 Course Content

Module-1

Diode Circuits: Diode clipping and clamping circuits.

Transistor biasing and stabilization: Operating point, analysis and design of fixed bias circuit, self-bias circuit, Emitter stabilized bias circuit, voltage divider bias circuit, stability factor of different biasing circuits. Problems. Transistor switching circuits

10 Hours



Module-2

Transistor at low frequencies: BJT transistor modelling, CE fixed bias configuration, voltage divider bias, emitter follower, CB configuration, collector feedback configuration, analysis using h – parameter model, relation between h – parameters model of CE, CC and CB modes, Millers theorem and its dual.

10 Hours

Module-3

Multistage 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.

10 Hours

Module-4

Power amplifiers: Amplifier types, analysis and design of different power amplifiers.
Oscillators: Principle of operation, analysis and derivation of frequency of oscillation of phase shift oscillator, Wien bridge oscillator, RF and crystal oscillator and frequency stability.

10 Hours

Module-5

FETs: Construction, working and characteristics of JFET and MOSFET. Biasing of JFET and MOSFET Analysis and design of JFET (only common source configuration with fixed bias) and MOSFET amplifiers

10 Hours

5.0 Relevance to future subjects

SI No	Semester	Subject	Topics
01	IV	Op Amp & Linear IC	Amplifiers, Oscillators
02	VIII	VLSI Circuits	MOSFET

6.0 Relevance to Real World

SI No	Real World Mapping
01	Design of various components like voltage regulator, oscillators etc.
02	Conduct investigations of complex Problems using basics of transistor parameters.
03	Development of prototype models.

7.0 Gap Analysis and Mitigation

SI No	Delivery Type	Details
01	Tutorial	Topic: Basic of diodes, transistors, transistor amplifiers, oscillators.
02	NPTEL	FET's & MOSFET

8.0 Books Used and Recommended to Students

Text Books
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, 2008
Reference Books
1. Microelectronics Circuits Analysis and Design by Muhammad Rashid Cengage Learning 2nd Edition, 2014. 2. A Text Book of Electrical Technology, Electronic Devices and Circuits by B.L. Theraja, A.K. Theraja S. Chand Reprint, 2013 3. Electronic Devices and Circuits S.Salivahanan N.Suresh Mc Graw Hill 3rd Edition, 2013. 4. Fundamentals of Analog Circuits Thomas L Floyd Pearson 2nd Edition, 2012
Additional Study material & e-Books
1. Electronic Devices and Circuits Anil K. Maini Vasha Agarwal Wiley 1st Edition, 2009



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://en.wikipedia.org/wiki/oscillators>

10.0

Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	AEÜ - International Journal of Electronics and Communications	www.journals.elsevier.com/aeu

11.0

Examination Note

Question paper pattern:

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

12.0

Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
MODULE 1	1, 2, 3	Diode Circuits: Diode clipping and clamping circuits.	20
	4, 5	Transistor biasing and stabilization: Operating point, analysis and design of fixed bias circuit	
	6	Self- bias circuit, Emitter stabilized bias circuit,	
	7, 8	Voltage divider bias circuit	
	9	Stability factor of different biasing circuits.	
	10	Transistor switching circuits Problems.	
MODULE 2	11	Transistor at low frequencies: BJT transistor modeling	20
	12,13	CE fixed bias configuration, voltage divider bias	
	14	emitter follower, CB configuration,	
	15	collector feedback configuration	
	16, 17	analysis using h – parameter model	
	18, 19	relation between h – parameters model of CE, CC and CB modes	
MODULE 3	20	Miller's theorem and its dual.	20
	21, 22	Multistage amplifiers: Cascade and cascode connections	
	23, 24, 25	Darlington circuits analysis and design	
	26, 27	Feedback amplifiers: Feedback concept, different types	
	28	Practical feedback circuits	
MODULE 4	29, 30	Analysis and design of feedback circuits.	20
	31	Power amplifiers: Amplifier types	
	32, 33	Analysis and design of different power amplifiers.	
	34, 35, 36	Oscillators: Principle of operation, analysis and derivation of frequency of oscillation of phase shift oscillator,	
	37, 38	Wien bridge oscillator	
MODULE 5	39, 40	RF and crystal oscillator and frequency stability.	20
	41, 42	FETs: Construction, working and characteristics of JFET and MOSFET.	
	43, 44, 45, 46	Biasing of JFET and MOSFET	
	47, 48, 49, 50	Analysis and design of JFET (only common source configuration with fixed bias) and MOSFET amplifiers	



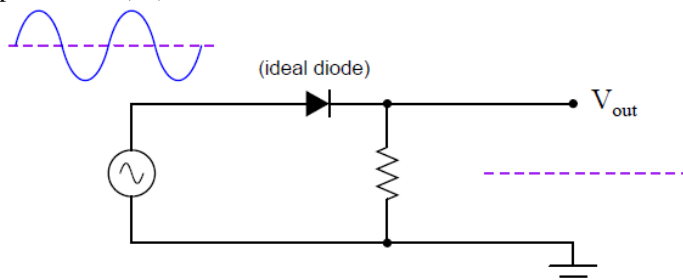
13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: Questions on module 1	Students study basics of diode circuits, transistors biasing.	Module 1 of the syllabus	3	Individual Activity.	Text 1 Ref Book 2
2	Assignment 2: Questions on module 2	Students study the transistors at low frequency and h-parameters.	Module 2 of the syllabus	5	Individual Activity.	Text 1 Ref Book 3
3	Assignment 3: Questions on module 3	Students study the multistage and feedback amplifiers.	Module 3 of the syllabus	8	Individual Activity.	Text 1 Ref Book 3
4	Assignment 4: Questions on module 4	Designing different oscillators.	Module 4 of the syllabus	10	Individual Activity.	Text 1 Ref Book 3
5	Assignment 5: Questions on module 5	Students Study FET's & MOSFET	Module 5 of the syllabus	12	Individual Activity.	Text 1 Ref Book 2

14.0 QUESTION BANK

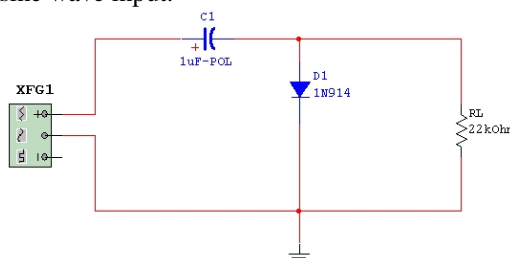
MODULE 1

1. What do you understand by 'reverse recovery time' of a diode? Explain.
2. Draw and explain the working of the clamper circuit which clamps the positive peak of a signal to zero volts.
3. Explain the different diode equivalent circuits with necessary approximations if any.
4. Define clipping circuit. Mention a few applications.
5. Draw the piece wise linear V-I characteristics of a PN junction diode. Give the circuit model for the ON state and OFF state.
6. How series clipper can be used to obtain
 - i) Clipping above the reference voltage VR
 - ii) Clipping below the reference voltage VR.
7. Draw and explain a double diode clipper circuit which limits the output at two independent levels.
8. With neat diagram and waveforms explain the working of a negative clamper.
9. Explain diffusion capacitor and transition capacitance of a PN junction diode.
10. Sketch the output voltage waveform for the clipper circuit shown, considering ideal diode with no forward voltage drop, input is $50\sin(\omega t)$.
11. forward voltage drop, input is $50\sin(\omega t)$.



12.

13. Sketch the output waveform for the clamper circuit, consider a forward voltage drop of 0.7V for the
14. Diode, for 20 volts peak to peak sine wave input.



15.



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 $10\text{K}\Omega$. It is supplied by a source of $1\text{K}\Omega$ internal resistance. The h parameters are $h_{ie}=1.1\text{k}\Omega$, $h_{fe}=50$, $h_{re}=2.5\times 10^{-4}$ and $h_{oe}=1/40\text{K}\Omega$.
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. Describe miller effect and derive an equation for miller input and output capacitances.
9. Discuss the factors that affect the low frequency response of a BJT-CE amplifier.

MODULE 3

1. What are the advantages of negative feedback in an amplifier?
2. Explain positive feedback and negative feedback mentioning the merits and demerits of each.
3. Give the classification of multistage amplifier. Explain the various distortions in amplifiers.
4. Discuss the general characteristics of a negative feedback amplifier.
5. Explain the concept of 'feedback' in amplifiers.
6. Explain the working of any one type of feedback amplifier and list its characteristics.
7. Derive an expression for the input resistance with feedback amplifier employing voltage series feedback.





MODULE 4

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. What is harmonic distortion? How the output signal gets distorted due to the harmonic distortion.
16. What are the conditions for sustained oscillator or what is Barkhausen criterion?
17. What is Oscillator circuit? What are the classifications of Oscillators? What are the conditions for oscillation?
18. Define Piezoelectric effect. Draw the equivalent circuit of crystal oscillator.
19. What are sinusoidal oscillators? Explain any two sinusoidal oscillators?
20. Explain the concept involved in crystal oscillator with its characteristics?
21. With the help of a neat circuit diagram, explain transistor Colpitts oscillator. Write the expression for the frequency of oscillation.
22. With the help of a neat circuit diagram, explain transistor Hartley oscillator. Write the expression for the frequency of oscillation.
23. Explain the characteristics of quartz crystal. With a neat diagram explain the oscillator in parallel resonant circuits.
24. Explain the working of RC phase shift oscillator and derive an expression for frequency of oscillation.
25. Draw the wein bridge oscillator using BJT. Show that the gain of the amplifier must be at least 3 for the oscillations to occur.
26. Show that for the oscillations to start in an phase shift oscillator, the minimum h_{fe} value of a transistor should be 44.5.



MODULE 5

1. Explain the differences between FET and BJT.
2. Give the output characteristic of JFET and mark the salient regions on the graph.
3. Write the comparison between depletion type MOSFET and enhancement type MOSFET.
4. With neat sketch, explain basic construction of depletion type MOSFET.
5. Draw and explain transfer and drain characteristics of n-channel depletion type MOSFET.

Prepared by	Checked by		
		 2/8	
Prof. Sagar S B	Prof. S. D. Hirekodi	HOD	Principal



Subject Title	DIGITAL SYSTEM DESIGN		
Subject Code	18EE35	IA Marks	40
Number of Lecture Hrs / Week	04	Exam Marks	60
Total Number of Lecture Hrs	52	Exam Hours	03

FACULTY DETAILS:

Name: Prof. A U Neshti	Designation: Asst Professor	Experience: 10
No. of times course taught: 01	Specialization: Digital Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electronics
02	Electrical & Electronics Engineering	III	Digital Electronics laboratory

2.0 Course Objectives

Upon completion of this course, a student should be able to:

- Illustrate simplification of Algebraic equations using Karnaugh Maps and Quine-McClusky Techniques.
- Design combinational logic circuits..
- Design Decoders, Encoders, Digital Multiplexer, Adders, Subtractors and Binary Comparators.
- Describe Latches and Flip-flops, Registers and Counters.
- Analyze Mealy and Moore Models.
- Develop state diagrams, Synchronous Sequential Circuits and to understand the basics of various Memories

3.0 Course Outcomes

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

	Course Outcome	RBT Level	POs
C205.1	Develop simplified switching equation using Karnaugh Maps and QuineMcClusky techniques.	L5	PO1,PO2,PO3
C205.2	Design Multiplexer, Encoder, Decoder, Adder, Subtractors and Comparator as digital combinational control circuits.	L5	PO1,PO2,PO3
C205.3	Design flip flops, counters, shift registers as sequential control circuits.	L5	PO1,PO2,PO3
C205.4	Develop Mealy/Moore Models and state diagrams for the given clocked sequential circuits.	L5	PO1,PO2,PO3
C205.5	Explain the functioning of Read only and Read/Write Memories, Programmable ROM, EPROM and Flash memory.	L2	PO1,PO2,PO3
Total Hours of instruction			50



4.0 Course Content

MODULE-1:

Principles of Combinational Logic: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3,4,5 variables, Incompletely specified functions (Don't care terms) Simplifying Max term equations, Quine-McCluskey minimization technique, Quine-McCluskey using don't care terms, Reduced prime implicants Tables

MODULE-2:

Analysis and Design of Combinational logic: General approach to combinational logic design, Decoders, BCD decoders, Encoders, digital multiplexers, Using multiplexers as Boolean function generators, Adders and subtractors, Cascading full adders, Look ahead carry, Binary comparators.

MODULE-3:

Flip-Flops: Basic Bistable elements, Latches, Timing considerations, The master-slave flip-flops (pulsed triggered flip-flops): SR flip-flops, JK flip-flops, Edge triggered flip-flops, Characteristic equations.

MODULE-4:

Flip-Flops Applications: Registers, binary ripple counters, synchronous binary counters, Counters based on shift registers, Design of a synchronous counter, Design of a synchronous mod-n counter using clocked T, JK, D and SR flip-flops.

MODULE-5:

Sequential Circuit Design: Mealy and Moore models, State machine notation, Synchronous Sequential circuit analysis, Construction of state diagrams, counter design. **Memories:** Read only and Read/Write Memories, Programmable ROM, EPROM, Flash memory.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	V	Microcontroller	--
02	VII	Embedded systems	--

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Embedded Systems
02	Computer field

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
02	NPTEL videos	Practical exposure regarding designing of digital circuit.



8.0 Books Used and Recommended to Students

Text/Reference Books				
1	Digital Logic Applications and Design	John M Yarbrough	Cengage Learning	2011
2	Digital Principles and Design	Donald D Givone	McGraw Hill Education	1 st Edition,
3	Logic and computer design Fundamentals	M. Morris Mano and Charles Kime	Pearson Learning	4 th Edition, 2014
4	Fundamentals of logic design	Charles H Roth, JR and Larry L.	Cengage Learning	6 th Edition,
5	Fundamentals of Digital Circuits	A. Anand Kumar	PHI	3 rd Edition,
6	Digital Logic Design and VHDL	A.A.Phadke S.M.Deokar	WileyIndia	1 st Edition,
7	Digital Circuits and Design	D.P.Kothari J.S.Dhillon	Pearson	First Print
8	HDL Programming(VHDL and Verilog)	NazeihM. Botros	Cengage Learning	1 st Edition,
9	Circuit Design and Simulation with	Volnei APedroni	PHI	2 nd Edition,

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

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

10.0 Magazines/Journals Used and Recommended to Students

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

11.0 Examination Note

Assignment marks: 10 marks.

Question paper pattern IA exam:

Answer two full questions Q1 or Q2 and Q3 or Q4 (15marks each). Total 30 Marks.

Question paper pattern Main exam:

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



12.0 Course Delivery Plan

MODULE	Lect. No.	Content of Lecture	% of Portion
Principles of Combinational Logic: MODULE-1	1	Introduction & definition of combinational & canonical forms	20
	2,3	Generation of switching equations from truth tables, Examples	
	4,5	Karnaugh maps-3, 4 and 5 variables. Incompletely specified functions (Don't care terms). examples	
	6,7	Simplifying Max term equations, examples' Incompletely specified functions (Don't Care terms), examples	
	8	Quine-McCluskey minimization technique, Examples	
	9	Quine-McCluskey using don't care terms, Reduced Prime Implicant tables examples,	
	10	Map entered variables, Examples	
Analysis and Design of Combinational logic MODULE-2	11	General approach, Decoders-BCD, decoders	20
	12	Decoders examples	
	13	Expansion of decoders	
	14,15	Encoders, examples, Adders and Subtractors,	
	16	Cascading full adders, Look ahead carry	
	17,18	Digital multiplexers -.	
	19	Digital multiplexers -.using multiplexers as Boolean function generators	
Flip-Flops: MODULE-3	21	Basic Bistable element, Latches, SR latch.	20
	22	Application of SR latch, A Switch debouncer, The gated SR latch. The gated DLatch	
	23	The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The master-slave SR Flip-Flops	
	24	The master-slave JK Flip-Flop	
	25,26	Edge Triggered Flip-flop: The Positive Edge-Triggered D Flip-Flop,	
	27	Negative-Edge Triggered D Flip-Flop.	
	28,29	Examples	
30,31	Characteristic equations		
Flip-Flops Applications MODULE-4	32	Registers,	20
	33,34	Counters-Binary Ripple Counter	
	35	Synchronous Binary counters,	
	36, 37	Counters based on Shift Registers	
	38	Design of a synchronous counter,	
	39	Design of a synchronous mod-n counter using clocked	
Sequential Circuit Design & Memories: MODULE-5	40	T, JK, D and SR flip-flops.	20
	41	Introduction, Mealy & model	
	42	Moore Model examples	
	43	State Machine Notation	
	44	Synchronous Sequential Circuit Analysis	
	45	Construction of state Diagrams, examples	
	46	Counter design.	
	47	Counter design.	
48	Read only and Read/Write Memories,		
49,50	Programmable ROM & EPROM & Flash memory.		



13.0 Assignments, Quiz

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment-1: Principles of combinational logic	Student will be able to develop simplified switching equation	Module-1	4	Individual	Book no 1,2
2	Assignment2: Analysis and design of Combinational Logic	Student will be able to design combinational circuits	Module-2	7	Individual	Book no 1,2
3	Assignment3: flip flops	Student will be able to design flip flops	Module-3	10	Individual	Book no 1,2
4	Assignment4: flip flops applications	Student will be able to design a counters	Module-4	13	Individual	Book no 1,2
5	Assignment5: Sequential Circuit Design & Memories:.	Student will be able to design Sequential Circuit & explain Memories	Module-5	15	Individual	Book no 1,2

14.0 Assignment Questions

Assignment No	Questions	Marks
I	1) Simplify the following using K-map a. $f(a,b,c,d) = \sum m(0,2,3,5,8,10,11)$ b. $f(a,b,c,d,e) = \sum m(3,7,8,10,11,12,14,15,17,19,21,23,25,27,29,31) + d(2,6,26,30)$ 2) Simplify the following using Quine-McCluskey method. a. $f(a,b,c,d) = \pi M(0,4,5,9).d(1,7,13)$ b. $f(a,b,c,d) = \sum m(0,2,3,5,8,10,11)$ 3) Simplify the following using MEV a. $f(a,b,c,d) = \sum m(0,4,8,10,14,15)$ using c as MEV variable. b. $f(a,b,c,d) = \sum m(0,4,8,10,14,15)$ using a,b as MEV variable.	20
II	1) Implement the multiple functions: $f_1(a,b,c,d) = \sum m(0,4,8,10,14,15)$ $f_2(a,b,c,d) = \sum m(3,7,9,13,15)$ using 3:8 decoder. 2) Design a full subtractor using 4:1 multiplexer. 3) Design & Implement 2-bit comparator. 4) Explain 4-bit parallel adder with look ahead carry scheme. 5) Implement 16:1 multiplexer using 4:1 multiplexer.	20
III	1) Explain with timing diagram, the working of SR latch as a switch debouncer. 2) Explain the working of Master-Slave JK Flip-flop with functional table & timing diagram. 3) What is edge triggered f/fs .Explain positive edge triggered D f/fs. With neat timing diagrams 4) Write the next state tables and characteristic equations for SR,JK,D and T f/f.	20



IV	1. What is a register? Explain with neat diagrams all the types of register. 2. Explain Universal shift register. 3. With a neat logic diagram and timing waveforms explain synchronous binary counters. 4. Explain with a neat diagram and timing waveforms Johnson counter and ring counter. 5. Design synchronous mod-6 counter using JK and D f/f.	20
V	1 Explain with neat diagram Mealy machine. 2 Explain with neat diagram Moore network. 3 Explain different types of sequential networks? 4 Differentiate between Mealy and Moore model. 5 What are excitation and transition expressions?	20

15.0

QUESTION BANK

MODULE-1

1. What is combinational Logic circuit? Explain.
2. Write the following minterm canonical formulas in algebraic form and construct truth tables
 $f(w,x,y,z)=\sum m(1,3,7,8,9,14,15)$
3. Explain canonical form of Boolean equations with an example.
4. Explain Karnaugh map representation in detail & discuss the merits & demerits.
5. Explain the definition of combinational logic circuit.
6. Transform each of the following canonical expression in to its other canonical form in decimal notation
a. $f(x,y,z)=\prod M(0,3,4)$ b. $f(x,y,z)=\sum m(1,3,5)$ c. $(a,b,c,d)=\sum m(1,2,4,6,9,15)$ d. $f(w,x,y,z)=\sum m(0,1,2,3,7,9,11,12,15)$
7. Express each of the following functions by a Maxterm Canonical formulae
a. $f(x,y,z)=(y+z')(xy'+z)$
b. $f(x,y,z)=x+x'z'(y+z)$
8. Using K-maps, determine all the prime implicants of each of the following functions. In each case, indicate the essential prime implicants
a. $f(w,x,y,z)=\sum m(0,1,2,5,6,7,8,9,10,13,14,15)$
b. $f(w,x,y,z)=\prod M(0,2,3,8,9,10,12,14)$
c. $f(w,x,y,z)=w'y'z+w'yz+x'y'z'+wx'y+w'x'yz'$
9. Using k-maps, determine all the minimal sums and minimal products for each of the following Boolean functions
a. $f(a,b,c,d)=\prod M(0,4,5,7,8,9,11,12,13,15)$
b. $f(x,y,z)=\sum m(0,1,2,3,4,6,7)$
c. $f(x,y,z)=\prod M(1,4,5,6)$
d. $f(w,x,y,z)=\sum m(0,1,6,7,8,14,15)$
e. $f(w,x,y,z)=\prod M(1,3,4,5,10,11,12,14)$
10. Give two simplified irredundant expressions for
a. $F(w,x,y,z)=\sum(0,4,5,7,8,9,13,15)$
b. Design a combinational logic ckt whose i/p is a 4-bit binary number and whose o/p is the 2's complement of the i/p number. Implement by using suitable logic
11. Using the Quine-McCluskey method, obtain all the prime implicants for each of the following Boolean functions



- a. $f(w,x,y,z) = \sum(0,2,3,4,8,10,12,13,14)$
 - b. $f(w,x,y,z) = \sum(7,9,12,13,14,15) + dc(4,11)$
 - c. $f(w,x,y,z) = \prod M(1,3,6,10,11,12,14,15,17,19,20,22,24,29)$
12. Simplify $f(a,b,c,d) = \sum(2,3,4,5,13,15) + dc(8,9,10,11)$ taking least significant as map-entered variable. Dec-2011

MODULE- 2

1. What is decoder? What are its advantages? Design a decimal decoder, which converts information from BCD to decimal
2. Construct 4 to 16 line decoder using 2-4 decoders
3. Using AND/NAND gates along with a 3-8-line decoder realize the pairs of expressions with minimum i/ps
 - a. $f_1(a,b,c) = \prod M(0,3,5,6,7)$
 - b. $f_2(a,b,c) = \prod M(2,3,4,5,7)$
4. Construct 16:1 MUX using 4 to 1 line MUX
 - a. Realize each of the following Boolean expressions using an 8 to 1 line Multiplexer where w,x,y appear on select lines S₂,S₁,S₀ respectively
 - b. $f(w,x,y,z) = \sum m(1,2,6,7,9,11,12,14,15)$
 - c. $f(w,x,y,z) = \sum m(2,5,6,7,9,12,13,15)$
Realize the Boolean expression. $f(w,x,y,z) = \sum m(4,5,7,8,10,12,15)$ Using a 4 to 1 line MUX and external Gates with I)
I) Let w and x appear on the select lines S₁ and S₀ respectively II) y and z appear on the select lines S₁ and S₀ respectively.
5. Design full adder and full subtractor. Implement using gates
6. What is a multiplexer? With neat sketch, describe 4:1MUX. Implement the given Boolean functions by using multiplexer chip
 - a. $F_1(A,B,C) = \sum m(1,2,4,7)$
 - b. $F_2(A,B,C) = \sum m(3,5,6,7)$
7. With neat block diagram explain carry look ahead adder in detail.
8. Design 2 bit comparator circuit using logic gates.
9. Design & implement 4 bit look ahead carry adder.
10. Implement 16:1 multiplexer using 4:1 multiplexer
11. Implement full subtractor using 3-8 line decoder with the decoder having high outputs & active low enable inputs
12. What is magnitude comparator? Write the truth table & logic diagram of a 1-bit comparator.

MODULE- 3:

1. Design a switch debouncer using SR and $\bar{S} \bar{R}$ latch.
2. Explain the operation of SR latch.
3. Explain the operation of the master-slave JK f/f and SR f/f along with its circuit diagram.
4. Explain the working of SR f/f by using NOR gates.
5. What is race around condition in f/f? Discuss in brief.
6. Difference between f/fs and latches and its definition.
7. What is edge triggered f/fs. Explain positive edge triggered D f/fs. With neat timing diagrams
8. Explain negative edge triggered D f/fs using NAND gates and timing diagrams.
9. What is propagation delay?
10. Explain with neat timing diagrams $S \bar{R}$ latch?
11. Write the next state tables and characteristic equations for SR,JK,D and T f/f.



MODULE-4:

1. What is a register? Explain with neat diagrams all the types of register.
2. Explain Universal shift register.
3. With a neat logic diagram and timing waveforms explain synchronous binary counters.
4. Explain with a neat diagram and timing waveforms Johnson counter and ring counter.
5. Design synchronous mod-6 counter using JK and D f/f.
6. Design a counter that has a repeated sequence of 06 states listed $0 \rightarrow 3 \rightarrow 4 \rightarrow 0 \rightarrow 5 \rightarrow 6$ diagram.
7. Design mod-3 counter using JK f/f. Sketch the waveforms for o/ps when clock is applied and verify its operation.
8. Explain with neat waveforms working of 4 bit shift register. Modify same as Johnson's counter.
9. Design a 4-bit synchronous up/down counter.

MODULE-5:

1. Explain with neat diagram Mealy machine.
2. Explain with neat diagram Moore network.
3. Explain different types of sequential networks?
4. Differentiate between Mealy and Moore model.
5. What are excitation and transition expressions?
6. Write a note on Moore & Mealy models with respect to design of sequential circuits. Compare the two models.
7. Construct a Mealy state diagram that will detect a serial sequence of 10110. When the i/p pattern has been detected, cause an o/p Z to be asserted high.

Prepared by	Checked by		
Prof. Amit Neshti	Prof. KB Negalur	HOD	Principal



Subject Title	Electrical & Electronics Measurements		
Subject Code	18EE36	IA Marks	40
Number of Lecture Hrs / Week	04	Exam Marks	60
Total Number of Lecture Hrs	40	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Dr. Basavaraj V. Madiggond	Designation: Professor & HOD	Experience: 26
No. of times course taught: 01	Specialization: Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & electronics engineering	I/II	Basic electronics
02	Electrical & electronics engineering	III	Digital system design

2.0 Course Objectives

- To measure resistance, inductance, capacitance using different bridges and determine earth resistance.
- To study the construction and working of various meters used for measurement.
- To study the adjustments, calibration & errors in energy meters and methods of extending the range of instruments.

3.0 Course Outcomes

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

	Course Outcome	Cognitive Level	POs
CO206.1	Measure resistance, inductance and capacitance using different bridges and determine earth resistance.	U,A	PO1, PO2, PO11, PO12
CO206.2	Explain the working of various meters used for measurement of Power, Energy & understand the adjustments, calibration & errors in energy meters.	U,A	PO1, PO2, PO11, PO12
CO206.3	Understand methods of extending the range of instruments & instrument transformers.	U	PO1, PO2, PO11, PO12
CO206.4	Explain the working of different electronic instruments.	U	PO1, PO2, PO11, PO12
CO206.5	Explain the working of different display and recording devices.	U	PO1, PO2, PO11, PO12
Total Hours of instruction			40



4.0 Course Content

Module-1

Measurement of Resistance: Wheatstone's bridge, sensitivity, limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger.

Measurement of Inductance and Capacitance: Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance and capacitance bridge, Hay's bridge, Anderson's bridge, Desauty's bridge, Schering bridge. Shielding of bridges. Problems. 8 Hours

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding, L3 – Applying.

Module-2

Measurement of Power, Energy, Power factor and Frequency: Torque expression, Errors and minimization, UPF and LPF wattmeters. Measurement of real and reactive power in 3 phase circuits. Errors, adjustments and calibration of single and three phase energy meters, Problems. Construction and operation of single-phase and three phase dynamometer type power factor meter. Weston frequency meter and phase sequence indicator. 8Hours

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing.

Module-3

Extension of Instrument Ranges: Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characteristics, Errors of CT and PT. Turns compensation, Illustrative examples, Silsbee's method of testing CT.

Magnetic measurements: Introduction, measurement of flux/ flux density, magnetising force and leakage factor. 8Hours

Revised Bloom's Taxonomy Level: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing.

Module-4

Electronic and digital Instruments: Introduction. Essentials of electronic instruments, Advantages of electronic instruments. True rms reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, Continuous – balance DVM and Successive - approximation DVM. Q meter. Principle of working of electronic energy meter (block diagram treatment), extra features offered by present day meters and their significance in billing. 8Hours

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

Module-5

Display Devices: Introduction, character formats, segment displays, Dot matrix displays, Bar graph displays. Cathode ray tubes, Light emitting diodes, Liquid crystal displays, Nixes, Incandescent, Fluorescent, Liquid vapour and Visual displays.

Recording Devices: Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders, Bridge type recorders, LVDT type recorders, Circular chart and xy recorders. Digital tape recording, Ultraviolet recorders. Electro Cardio Graph (ECG), Electroencephalograph, 10Hours

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



5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project work	Students can apply the knowledge of different type's bridges & display devices to measure & display the data.

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Fundamental knowledge of different systems of units & si system of units.
02	Basic knowledge of measurement of resistance, Inductance & capacitance.
03	Basic Knowledge of use different recording and display devices, Instrument transformers.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
02	NPTEL & conducting Extra Classes.	Awareness towards to the use of different bridges, display & recording devices in labs.

8.0 Books Used and Recommended to Students

Text Books
<ul style="list-style-type: none"> ➤ Electrical and electronic Measurements and Instrumentation by A.K. Sawhney 10th Edition Dhanpat Rai and Co. ➤ A Course in Electronics and Electrical Measurements and Instrumentation by J. B. Gupta 2013 Edition Katson Books.
Reference Books
<ul style="list-style-type: none"> ➤ Electrical and electronic Measurements and Instrumentation by Er.R.K. Rajput 5th Edition 2012 S Chand. ➤ Electrical Measuring Instruments and Measurements by S.C. Bhargava 2013BS Publications. ➤ Modern Electronic Instrumentation and Measuring Techniques by Cooper D and A.D. Heifrick First Edition 2015 Pearson. ➤ Electronic Instrumentation by H.S.Kalsi 3rd Edition 2010 Mc Graw Hill. ➤ Electronic instrumentation and measurements by David A Bell Oxford University 3rd Edition, 2013.
Additional Study material & e-Books
<ul style="list-style-type: none"> ➤ Electrical & Electronic measurements by P.M.Chandrashekar.

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

Website and Internet Contents References
<ol style="list-style-type: none"> 1) https://books.google.co.in/books?isbn=125902959X 2) http://NPTEL.com/ 3) www.electrical4u.com



10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Instrumentation & measurement magazine	ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5289
2	Electrical & Electronic industry trade publications journals magazines	www.industryart.com › Industrial Publications
3	IEEE journals & magazines	https://www.ieee.org › Publications

11.0 Examination Note

Internal Assessment: 40 Marks

There are four main questions of 20 Marks

Students have to answer any two full questions of each 20Marks selecting one from Q.No 1 & Q.No 2.

Scheme of Evaluation for Internal Assessment (40 Marks)

(a) Internal Assessment test will be done in the same pattern as that of the main examination (Better of the two Tests):

SCHEME OF EXAMINATION:

The question paper will have ten questions.

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

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecture	% of Portion
1	1.	Wheatstone's bridge, sensitivity, limitations.	20%
	2.	Kelvin's double bridge.	
	3.	Earth resistance measurement by fall of potential method. Earth resistance measurement by using Megger.	
	4.	Sources and detectors, Maxwell's inductance bridge.	
	5.	Maxwell's inductance and capacitance bridge.	
	6.	Hay's bridge, Anderson's bridge.	
	7.	Desauty's bridge, Schering bridge.	
	8.	Shielding of bridges, Problems.	
2	9.	Torque expression, Errors and minimization.	20%
	10.	UPF and LPF wattmeters.	
	11.	Measurement of real and reactive power in 3 phase circuits.	
	12.	Errors, adjustments and calibration of single and three phase energy meters,	
	13.	Construction and operation of single-phase dynamometer type power factor meter. Weston	
	14.	Construction and operation of three phase dynamometer type power factor meter. Weston	
	15.	Weston frequency meter	
	16.	Phase sequence indicator.	
3	17.	Extension of Instrument Ranges: Desirable features of ammeters and voltmeters.	
	18.	Shunts and multipliers.	
	19.	Construction and theory of instrument transformers, Desirable characteristics.	
	20.	Errors of CT and PT, Turns compensation.	



	21.	Silsbee's method of testing CT.	20%
	22.	Magnetic measurements: Introduction to magnetic measurement	
	23.	Measurement of flux/ flux density	
	24.	Magnetizing force and leakage factor.	
4	25.	Electronic and Digital Instruments: Introduction, Essentials of electronic instruments, Advantages of electronic instruments.	20%
	26.	True RMS reading voltmeter. Electronic Multimeters	
	27.	Digital voltmeters (DVM) - Ramp type DVM	
	28.	Integrating type DVM	
	29.	Successive - approximation DVM.	
	30.	Q meter	
	31.	Principle of working of electronic energy meter	
	32.	Extra features offered by present day meters and their significance in billing.	
5	33.	Display Devices: Introduction, character formats, segment displays,	20%
	34.	Dot matrix displays, Bar graph displays. Cathode ray tubes	
	35.	Light emitting diodes, Liquid crystal displays, Nixes	
	36.	Incandescent, Fluorescent,	
	37.	Liquid vapour and Visual displays.	
	38.	Recording Devices: Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders,	
	39.	Potentiometer type recorders, Bridge type recorders, LVDT type recorders,	
	40.	Circular chart and xy recorders, Digital tape recording, Ultraviolet recorders. Biomedical recorders, Electro Cardio Graph (ECG),	

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, measurement of resistance, Inductance & capacitance.	Students are capable to explain measurement of resistance, inductance & capacitance by different bridges.	Module 1	2	Individual Activity. Written solution expected.	Book 1, 2,3 of the text book list. Website of the Reference list
2	Assignment 2: University Questions on Measurement of power, Energy, power factor & frequency.	Students understand the measurement of power, energy, power factor & frequency using different meters.	Module 2	4	Individual Activity. Written solution expected.	Book 1, 2, 3 of the text book list. Website of the Reference list
3	Assignment 3: University Questions on Extension of Instrument ranges & Magnetic measurements.	Students explain the extension of instrument ranges & magnetic measurements.	Module 3	6	Individual Activity. Written solution expected.	Book 1,2, 3 of the text book list. Website of the Reference list
4	Assignment 4: University Questions on Electronic & digital instruments.	Students understand working of different Electronic & digital instruments.	Module 4	8	Individual Activity. Written solution expected.	Book 1, 2, 3 of the text book list. Website of the Reference list
5	Assignment 5: University Questions on Display devices & Recording devices.	Students are capable to elaborate working of different display & recording devices.	Module 5	10	Individual Activity. Written solution expected.	Book 1, 2, 3 of the text book list. Website of the Reference list



14.0 Question Bank

MODULE-I

1. Define the sensitivity of wheatstone's bridge & with neat sketch derive the expression for sensitivity of the bridge?
2. Classify resistance.
3. What is the range of medium resistance?
4. Name the methods used for low resistance measurement.
5. Name the methods used for medium resistance measurement
6. State the advantages of Wheatstone bridge method.
7. State the advantages of Kelvin double bridge method.
8. What are the constructional features of doctor ohmmeter?
9. Derive the balance equation for kelvin's double bridge?
10. Define megger.
11. Explain the measurement oh high resistance using megger?
12. What is the range of low resistance?
13. What is the range of medium resistance?
14. What ranges of resistance can be measured by using doctor ohmmeter.
15. How resistance is measured in direct deflection method.
16. How resistance is measured by using ohmmeter method.
17. State the balance equation used in bridge methods.
18. How the earth resistance is measured.
19. State the use of ac bridges.
20. State the balance equation used in ac bridges.
21. Name the bridge circuits used for the m/s of self-inductance.
22. Name the bridge circuits used for the m/s of capacitance.
23. Name the bridge circuits used for the m/s of mutual inductance.
24. Which type of detector is used in ac bridges?
25. Name the ac sources used in ac bridges.
26. In which cases audio frequency oscillators are used as ac source.
27. Name the sources of errors in ac bridge m/s.
28. State the advantages of Maxwell-wein bridge.
29. State the disadvantage of Maxwell-wein bridge.
30. State the disadvantages of Hay's bridge.
31. State the use of Wein bridge.
32. (i) Explain Kelvin's double bridge method for the measurement of low resistance.
(ii) Explain how inductance in measured by using Maxwell's bridge.

MODULE-2

1. Derive the torque equation of single phase electrodynamicometer type wattmeter?
2. What are the constructional parts of dynamometer type wattmeter?
3. State the disadvantages of Dynamometer type wattmeter.
4. Name the errors caused in Dynamometer type wattmeter.
5. How the errors caused by pc inductance is compensated.
6. How the errors caused by methods of connection is compensated
7. Name the methods used for power measurement in three phase circuits.
8. What are the special features to be incorporated for LPF wattmeter?
9. Name the methods used in Wattmeter calibration.
10. What are the types of energy meters?
11. Name the constructional parts of induction type energy meter?
12. How voltage coil is connected in induction type energy meter?
13. How current coil is connected in induction type energy meter?
14. Why Aluminium disc is used in induction type energy meter.
15. What is the purpose of registering mechanism?
16. What is the purpose of braking mechanism?
17. Define creeping?
18. Explain the principle of operation of 10W power factor wattmeter?
19. If the reading on two wattmeter's in 3-phase balanced load are 836 & 224W the latter reading being obtained after the reversal of current coil connections calculate the power factor of the load?
20. Discuss the various adjustments required in energy meter for the accurate reading?
21. With neat sketch explain the construction & working of Weston frequency meter?



MODULE-3

1. State the advantages of instrument transformers.
2. State the disadvantage of instrument transformers.
3. What are the constructional parts of current transformer?
4. Name the errors caused in current transformer.
5. Define ratio error.
6. What is shunt? How it is used to extend the range of an ammeter?
7. Write a note on turns compensation used in instrument transformers?
8. With neat circuit diagram explain silsbee's method of testing of CT?
9. Explain the wattmeter method of measuring the iron loss?
10. State the use of potential transformer.
11. Name the errors caused in potential transformer.
12. How the CT and PT are connected in the circuits.
13. What are the functional elements of an instrument?
14. What is meant by accuracy of an instrument?
15. Write the function of instrument transformer.
16. Why an ammeter should have a low resistance?

MODULE-4

1. With neat sketch explain the working of true RMS reading voltmeter?
2. With a neat diagram explain the working of an electronic multimeter?
3. What are the errors in the measurement of Q-factor of a coil? Explain
4. With a block diagram, explain the principle of working of electronic energy meter?
5. Discuss in detail the working of the successive approximation DVM?
6. With a neat diagram, explain the various methods of magnetic measurements?
7. With a neat diagram explain the construction and working of electro-dynamometer type Instruments. Also derive its torque equation?
8. Explain with neat diagram the working of linear ramp type DVM?

MODULE-5:

- 1 Explain LED and LCD displays?
- 2 Write a short note on Nixie tube?
- 3 Write a short note on strip chart recorder?
- 4 With a neat sketch explain the working of X-Y recorder?
- 5 With the help of neat block diagram explain ECG machine. Write important features of ECG machine?
- 6 What is power requirement of LCD?
- 7 What is LVDT?
- 8 List the advantages and disadvantages of LVDT.
- 9 What is thermocouple?
- 10 What are the advantages and disadvantages of LVDT?
- 11 With neat sketch explain dot matrix displays?

15.0 University Result

Examination	S+	S	A	B	C	D	E	F	% Passing
Dec 2017	--	1	6	7	17	9	9	5	90.74
Dec 2018	--	--	--	2	9	6	8	--	100

Prepared by	Checked by		
Dr. B. V. Madiggond	Prof. S. B. Patil	HOD	Principal



Subject Title	ELECTRICAL MACHINES LABORATORY - 1		
Subject Code	18EEL37	CIE Marks	40
No. of Lecture hrs./Week(L:T:P)	0:2:2	SEE Marks	60
		Exam Hours	03
CREDITS – 02			

FACULTY DETAILS:		
Name: Prof. S B Patil	Designation: Asst. Professor	Experience: 34 Years
No. of times course taught: 02 Times	Specialization: Power and Energy System	
Name: Prof. P. M. Murari	Designation: Asst. Professor	Experience: 08 Years
No. of times course taught: 02 Times	Specialization: Power system & Power Electronics	

1.0 Prerequisite Subjects:

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

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	Cognitive Level	POs
CO207.1	Evaluate the performance of transformers from the test data obtained.	Ap, A, E, C	PO1, PO2, PO4, PO5
CO207.2	Connect and operate two single phase transformers of different KVA rating in parallel.	Ap, A, E, C	PO1, PO2, PO4, PO5
CO207.3	Connect single phase transformers for three phase operation and phase conversion.	Ap, A, E, C	PO1, PO2, PO4, PO5
CO207.4	Compute the voltage regulation of synchronous generator using the test data obtained in the	Ap, A, E, C	PO1, PO2, PO4, PO5
CO207.5	Evaluate the performance of synchronous generators from the test data and assess the performance of synchronous generator connected to infinite bus.	Ap, A, E, C	PO1, PO2, PO4, PO5
Total Hours of instruction			42

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 the 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	Fundamentals of EML 1
02	IV	Electric motors	Fundamentals of EML 1

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 systems Theodore 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

Internal Assessment:

Question can appear on any of experiment.

Scheme of Evaluation for Internal Assessment (40 Marks)

Internal Assessment test in the same pattern as that of the main examination (40marks).

Write up	3 Marks
Conduction	5 Marks
Viva – Voce	2 Marks
Continuous Evaluation Journal	10 Marks
Attendance	5 marks
	15 marks

(Behaviour of students,
Conduction of experiments,
Viva Voce, Discipline, Submission of record)

40 Marks

SCHEME OF EXAMINATION:

One question can be set on any of the experiment

Write up	8 Marks
Conduction	45 Marks
Viva – Voce	7 Marks

Total 60 Marks

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 given the 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	Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines.	8.33
11	Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.	8.33
12	Power angle curve of synchronous generator.	8.33

12.0 QUESTION BANK

- 1) Define Transformer?
- 2) Mention different classifications of Transformer?
 1. Give the constructional details of the core & winding part of the transformer,
 2. Compare core type & shell type transformers.
 3. Power transformer are designed to give good
 - a. all day efficiency
 - b. power efficiency
 4. Distribution transformer are designed to give good
 - b. all day efficiency
 - b. power efficiency
 5. Transformer is "Constant flux Machine" True/False, Justify



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

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Prof. Pramod Murari	Prof. Amit Neshti	HOD	Principal



Subject Title	ELECTRONICS LABORATORY		
Subject Code	18EEL38	CIE Marks	40
Number of Lecture Hrs / Week	02+ 02	SEE Marks	60
Total Number of Lecture Hrs	52	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Prof. Sagar S B	Designation: Asst. Professor	Experience: 07 Years
No. of times course taught: 04		Specialization: VLSI Design & Embedded Systems

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

- To design and test half wave and full wave rectifier circuits.
- To design and test different amplifier and oscillator circuits using BJT.
- To study the simplification of Boolean expressions using logic gates.
- To realize different Adders and Subtractors circuits.
- To design and test counters and sequence generators.

3.0 Course Outcomes

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

	Course Outcome	Cognitive Level	Revised Bloom's Taxonomy Level	POs
CO204.1	Design and test rectifier circuits with and without capacitor filters.	U, A	L1, L2, L3, L4	1,2,5,8,9
CO204.2	Determine h-parameter models of transistor for all modes.	U, A	L2, L3, L4, L5	1,2,5,8,9
CO204.3	Design and test BJT and FET amplifier and oscillator circuits.	U, A	L1, L2, L3, L4	1,2,5,8,9
CO204.4	Realize Boolean expressions, adders and subtractors using gates.	U, A	L1, L2, L3, L4	1,2,5,8,9
CO204.5	Design and test Ring counter/Johnson counter, Sequence generator and 3 bit counters.	U, A	L1, L2, L3, L4	1,2,5,8,9
Total Hours of instruction			52	

4.0 Course Content

- Design and Testing of Full wave – centre tapped transformer type and Bridge type rectifier circuits with and without Capacitor filter. Determination of ripple factor, regulation and efficiency.
- Static Transistor characteristics for CE, CB and CC modes and determination of h parameters.
- Frequency response of single stage BJT and FET RC coupled amplifier and determination of half power points, bandwidth, input and output impedances.
- Design and testing of BJT - RC phase shift oscillator for given frequency of oscillation.
- Determination of gain, input and output impedance of BJT Darlington emitter follower with and without bootstrapping.



6. Simplification, realization of Boolean expressions using logic gates/Universal gates.
7. Realization of half/Full adder and Half/Full Subtractors using logic gates.
8. Realization of parallel adder/Subtractors using 7483 chip- BCD to Excess-3 code conversion & Vice -Versa.
9. Realization of Binary to Gray code conversion and vice versa.
10. Design and testing Ring counter/Johnson counter.
11. Design and testing of Sequence generator.
12. Realization of 3 bit counters as a sequential circuit and MOD – N counter design using 7476, 7490, 74192, 74193.

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	V	Power Electronics	Rectifiers, MOSFETs, FETs
02	VIII	Project work	Designing of components for project

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Design of various components
02	Conduct investigations of complex Problems
03	Development of prototype models

7.0 Books Used and Recommended to Students

Text Books	
1.	‘Electronic Devices and Circuit Theory’, Robert L Boylestad Louis Nashelsky Published by Pearson 11 th Edition 2015.
2.	Fundamentals of Analog Circuits Thomas L Floyd Pearson 2nd Edition, 2012.
3.	Electronic Devices and Circuits S.Salivahanan N.Suresh Mc Graw Hill 3rd Edition, 2013
4.	Electronic Devices and Circuits Anil K. Maini Vasha Agarval Wiley 1st Edition, 2009
Reference Books	
1.	Integrated Electronics, Analysis and Digital Circuits and Systems Jacob Millman et al Mc Graw Hill 2 nd
Additional Study material & e-Books	
1.	“Digital Integrated Electronics” by H. Taub and D. Schilling
2.	https://www.aec.at/futurelab/en/

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

Website and Internet Contents References	
http://www.audiomisc.co.uk/Electronics/audio/BasicAnalogue.pdf	
http://www.electricvlab.com/downloads/manual-vtu-analog-electronics.pdf	

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	AEÜ - International Journal of Electronics and Communications	www.journals.elsevier.com/aeu
2	Electronics for you	https://electronicsforu.com/



10.0 Examination Note

Internal Assessment:

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

Scheme of Evaluation for Internal Assessment (40 Marks)

- (a) Internal Assessment test in the same pattern as that of the main examination: 10 marks.
- (b) Continuous Assessment: 30 marks

Scheme of Examination:

- One question to be set from list of experiments for 10 Marks
- Write up- 2 marks
- Conduction and Result- 6 marks
- Viva Voce- 2 marks
- Continuous assessment/ Journal Writing- 30 marks

11.0 Course Delivery Plan

Expt No	Pract No	Name of the Experiment	% Of Portion
1	1	Design and Testing of Full wave – centre tapped transformer type and Bridge type rectifier circuits with and without Capacitor filter. Determination of ripple factor, regulation and efficiency.	8.33%
2	2	Static Transistor characteristics for CE, CB and CC modes and determination of h parameters.	8.33%
3	3	Frequency response of single stage BJT and FET RC coupled amplifier and determination of half power points, bandwidth, input and output impedances.	8.33%
4	4	Design and testing of BJT - RC phase shift oscillator for given frequency of oscillation.	8.33%
5	5	Determination of gain, input and output impedance of BJT Darlington emitter follower with and without bootstrapping.	8.33%
6	6	Simplification, realization of Boolean expressions using logic gates/Universal gates.	8.33%
7	7	Realization of half/Full adder and Half/Full Subtractors using logic gates.	8.33%
8	8	Realization of parallel adder/Subtractors using 7483 chip- BCD to Excess-3 code conversion & Vice -Versa.	8.33%
9	9	Realization of Binary to Gray code conversion and vice versa.	8.33%
10	10	Design and testing Ring counter/Johnson counter.	8.33%
11	11	Design and testing of Sequence generator.	8.33%
12	12	Realization of 3 bit counters as a sequential circuit and MOD – N counter design using 7476, 7490, 74192, 74193.	8.33%

12.0 QUESTION BANK

<ol style="list-style-type: none"> 1. What is a rectifier? 2. Why do you need a rectifier? 3. What is the meaning of ripple? 4. What are the different filter configurations available to remove these ripples? 5. What is the value of ripple factor for a Full wave rectifier? Is this different for a Bridge rectifier? 6. What is the value of efficiency for a Full wave rectifier? Is this different for a Bridge rectifier? 7. Write the equation for the ripple factor of a full wave rectifier with C – filter. 8. Write the equation for V_{dc} of a full wave rectifier with C – filter. 9. What is an amplifier? 	<ol style="list-style-type: none"> 27. What decides the maximum signal handling capacity of the FET RC coupled amplifier? 28. What are power amplifiers? 29. How are power amplifiers different from conventional Voltage or Current amplifiers? 30. Define the efficiency of a power amplifier. 31. What are the efficiencies of R-C Coupled Class A, Single ended Class A and Class B power amplifiers? 32. What are the disadvantages of Class B power amplifiers with center tapped transformer? 33. What is cross –over distortion? What is the reason for this distortion? 34. How this distortion can be eliminated? Explain. 35. What are ‘complimentary symmetry’ transistors?
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<p>10. What kind of bias should be applied for the transistor to act as an amplifier?</p> <p>11. What are the bias conditions for transistor to be in (a) Saturation region? (b) Cut – off region? (c) Active region?</p> <p>12. What is early effect? Is it an advantage or a disadvantage?</p> <p>13. Mention different types of transistor biasing methods.</p> <p>14. Which biasing method provides stabilization against variations in I_{CO}, β, V_{BE}?</p> <p>15. What are the different methods of coupling amplifier stages?</p> <p>16. What is the advantage of RC Coupling?</p> <p>17. Write an expression for the mid – band voltage gain for a single stage RC coupled amplifier</p> <p>18. Which are the components that affect the lower cut – off frequency?</p> <p>19. Which are the components that affect the upper cut – off frequency?</p> <p>20. Does the Emitter by – pass capacitor have any effect on the cut – off frequencies? Which cut – off frequency will it affect?</p> <p>21. Write an expression for the voltage gain of the amplifier in the low frequency region in terms of mid-band gain and lower cut – off frequency</p> <p>22. Write an expression for the voltage gain of the amplifier in the high frequency region in terms of mid-band gain and upper cut – off frequency.</p> <p>23. What are the merits and de-merits of the R–C Coupled amplifier?</p> <p>24. What are the classifications of Field effect transistors?</p> <p>25. Write the symbols for an N – Channel JFET and a P – Channel JFET.</p> <p>26. What are the advantages of Field effect transistors?</p>	<p>36. Write the applications of Power amplifier.</p> <p>37. What is an oscillator? What kind of feedback is used in oscillator circuits?</p> <p>38. What are the conditions to be satisfied in order to produce oscillations? What are these conditions called?</p> <p>39. Write other versions of Hartley oscillator circuits.</p> <p>40. What are Relaxation Oscillators?</p> <p>41. Why LC oscillators are not suitable for Audio frequencies?</p> <p>42. What is a half adder?</p> <p>43. What is a full adder?</p> <p>44. What are the applications of adders?</p> <p>45. What is a half subtractor?</p> <p>46. What is a full subtractor?</p> <p>47. What are the applications of subtractors?</p> <p>48. Obtain the minimal expression for above circuits.</p> <p>49. Realize a full adder using two half adders</p> <p>50. Realize a full subtractors using two half subtractors</p> <p>51. What is the internal structure of 7483 IC?</p> <p>52. What do you mean by code conversion?</p> <p>53. What are the applications of code conversion?</p> <p>54. How do you realize a subtractor using full adder?</p> <p>55. What is a ripple Adder? What are its disadvantages?</p> <p>56. What are code converters?</p> <p>57. What is the necessity of code conversions?</p> <p>58. What is gray code?</p> <p>59. Realize the Boolean expressions for a) Binary to gray code conversion b) Gray to binary code conversion</p> <p>60. What is the necessity for sequence generation? What are PISO, SIPO, and SISO with respect to shift register?</p> <p>61. Differentiate between serial data & parallel data</p> <p>62. What is the significance of Mode control bit?</p> <p>63. What is a ring counter?</p> <p>64. What is a Johnson counter?</p> <p>65. How many Flip-flops are present in IC 7495?</p>
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		218	
Prof. Sagar S B	Prof. S. D. Hirekodi	HOD	Principal