

	SJP NTrust's Hirasugar Institute of Technology, Nidasoshi <i>Inculcating Values, Promoting Prosperity</i> Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	EEE Dept.
		Academic
		Course Plan
		2025-26 (Odd Sem)



INSTITUTE VISION

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

INSTITUTE MISSION

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

DEPARTMENT VISION

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

DEPARTMENT MISSION

- I. To educate students with core knowledge of Electrical and Electronics Engineering to excel in their professional career.
- II. To develop problem solving skills, professional skills and ethical values among the students for the betterment of mankind.
- III. To prepare technically competent and socially responsible Electrical Engineer to serve the future needs of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the program will be able to

- PEO1: Achieve successful professional career in Electrical Engineering and allied disciplines.
- PEO2: Pursue higher studies and continuously engage in upgrading the professional skills.
- PEO3: Demonstrate professional & ethical values, effective communication skills and teamwork to solve issues related to profession, society and environment.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

	SJP NTrust's Hirasugar Institute of Technology, Nidasoshi <i>Inculcating Values, Promoting Prosperity</i> Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	EEE Dept.
		Academic
		Course Plan
		2025-26 (Odd Sem)

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

PROGRAM SPECIFIC OUTCOMES (PSOs) :

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

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

	SJP NTrust's Hirasugar Institute of Technology, Nidasoshi <i>Inculcating Values, Promoting Prosperity</i> Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	EEE Dept.
		Academic
		Course Plan
		2025-26 (Odd Sem)

Contents of III-SEM

S N	TOPIC	PAGE NO
1	Vision, Mission, PEOs, POs and PSOs	I
2	Student Help Desk	III
3	Departmental Resources	IV
4	Teaching Faculty Details	V
5	Institute Calendar of Events	VI
6	Dept. Calendar of Events	VII
7	Scheme of Teaching & Examination	VIII
8	Course Plans , Question Bank & Assignment Questions	
	Courses	
	BMATE301-Engineering Mathematics for EEE (PCC)	
	BEE302-Electric Circuit Analysis (IPCC)	
	BEE303-Analog Electronic Circuits (IPCC)	
	BEE304-Transformers and Generators (PCC)	
	BEEL305-Transformers and Generators lab (PCCL)	
	BEEL358B- 555 IC Laboratory (AEC)	
	BEE306A-Digital Logic Circuits (ESC)	

PCC: Professional Core Course, **IPCC:** Professional Core Course Theory Integrated with practicals,
PCCL: Professional Core Course laboratory, **AEC:** Ability Enhancement Course,
ESC: Engineering Science Course

	SJP NTrust's Hirasugar Institute of Technology, Nidasoshi <i>Inculcating Values, Promoting Prosperity</i> Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	EEE Dept.
		Academic
		Course Plan
		2025-26 (Odd Sem)

1.0 Student Help Desk

Sl. No	Coordination Work	Contact Person	
		Faculty	Instructor
01	Attestations	Dr. B. V. Madiggond	-
02	Exam forms signature, Overall department administration, Counseling/ interaction with Parents/Students.		
03	Research Centre Coordinator, Academic Coordinator		
04	Project Coordinator, KSCST Coordinator, Hobby & Mini Project Coordinator, Dept. Library Coordinator	Prof. S. D. Hirekodi	-
05	Academic Coordinator	Prof. H. R. Zinage	-
06	First Year Coordinator, Dept. NBA Coordinator, Alumni Coordinator	Dr. M. P. Yenagimath	-
07	Dept. Association Coordinator	Prof. O. B. Heddurshetti	-
08	AICTE/VTU/NIRF/LIC Coordinator, AICTE Activity Coordinator, Professional Body (ISTE & IEEE)Coordinator	Prof. A. U. Neshti	-
09	IA & EMS Coordinator	Prof. S. J. Patil	Shri. G. B. Rendale
10	News letter/Technical Magazine Coordinator, News & Publicity Coordinator, Website Coordinator, Mentorship Coordinator	Prof. S. G. Huddar	--
11	TP Cell Coordinator, IIIC Cell, Internship Coordinator, Technical Seminar Coordinator	Prof. P. I. Savadatti	--
12	Dispensary	Dr. Arun G. Bullannavar, Contact No.9449141549	
Class Teacher			
13	3 rd Semester	Prof. S. D. Hirekodi	Shri. G. B. Rendale
14	5 th Semester	Prof. H. R. Zinage	Shri. V.M. Mutalik
15	7 th Semester	Prof. O. B. Heddurshetti	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	10	19 Y
2	Technical supporting staff	4	28 Y
3	Helper	2	22 Y

	SJP NTrust's Hirasugar Institute of Technology, Nidasoshi <i>Inculcating Values, Promoting Prosperity</i> Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	EEE Dept.
		Academic
		Course Plan
		2025-26 (Odd Sem)

2.2 Major Laboratories

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

3.0 Faculty Details

S.N.	Faculty Name	Designation	Qualification	Area of specialization	Professional membership	Industry Experience (in years)	Teaching Experience (in years)	Contact Nos.
01	Dr.B.V.Madiggond	HOD/Prof.	Ph.D	Power Electronics	LMISTE, YHAI	-	32	9343454993
02	Dr. M. P.Yenagimath	Asst. Prof.	Ph.D	VLSI&ES	LMISTE	1	19	9341449466
03	Prof.S.D.Hirekodi	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	25	9480849338
04	Prof.H.R.Zinage	Asst. Prof.	M. Tech.	Power System	LMISTE	-	25	9480849335
05	Prof.O.B.Heddurshetti	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	18	9448420509
06	Prof. A. U. Neshti	Asst. Prof.	M. Tech.	Digital Electronics	ISTE	-	17	9538223362
07	Prof. S. G. Huddar	Asst. Prof.	M. Tech.	Power System Engg.	LMISTE	-	12	9742066852
08	Prof. P. I. Savadatti	Asst. Prof.	M. Tech.	Digital Electronics	-	-	10	9964315436
09	Prof. S. J. Patil	Asst. Prof.	M. Tech.	Industrial Electronics	-	-	12.5	9880931802



SJP NTrust's

Hirasugar Institute of Technology, Nidasoshi*Inculcating Values, Promoting Prosperity*

Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi

Recognized under 2(f) & 12B of UGC Act, 1956

Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE

EEE Dept.

Academic

Course Plan

2025-26
(Odd Sem)**4.0****Institute Calendar of Events**

	S J P N Trust's Hirasugar Institute of Technology, Nidasoshi. Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE	IQAC File 1-II AY:2025-26 (Odd) Rev: 03
--	--	---

**COMPREHENSIVE CALENDAR OF EVENTS (CoE) FOR THE AY: 2025-26
AND CoE FOR THE SUMMER SEMESTER OF AY: 2024-25**(Regular Odd Sems.: V & VII, w.e.f.: 4th Aug. 2025, Published on: 24th July 2025)

- Ref: 1. VTU CoE Notification No.: VTU/BGM/BoS/Academic Calendar/2024-25/1588, Dated : 12th July 2025
2. VTU Summer Semester CoE Notification No.: VTU/BGM/BoS/Academic Calendar/2024-25/1657, Dated : 15th July 2025
3. VTU Holiday Notification No.: VTU/BGM/Est/CR (4)/2024-25/1580, Dated : 10th Dec. 2024

Calendar	Date	Events & Holidays
August -2025	4 th Aug. 2025	Commencement of Regular V & VII and Summer Semester Classes for Registered Courses (Ref.2)
Sun Mon Tue Wed Thu Fri Sat	22 nd -23 rd Aug. 2025	1 st IA Test & CCAs of Summer Sem. (On 02 COs)
31	23 rd Aug. 2025	1 st Feedback on T & L of Summer Sem
3 4 5 6 7 8 9	25 th Aug. 2025	Display of 1 st IA Test & CCAs Marks of Summer Sem.
10 11 12 13 14 15 16	23 rd Aug. 2025	Ideathon & Project Synopsis Presentation (Mini & Major)
17 18 19 20 21 22 23	11 th -12 th Sept. 2025	2 nd IA Test & CCAs of Summer Sem. (On remaining 03 COs)
24 25 26 27 28 29 30	12 th Sept. 2025	2 nd Feedback on T & L of Summer Sem
15 th GH: Independence Day	13 th Sept. 2025	Display of 2 nd IA Test & CCAs Marks of Summer Sem.
18 th LH: Shrawan Last Monday (Tentative)	13 th Sept. 2025	Last Working Day of the Summer Semester
27 th GH: Varasidhi Vinayaka Vratha	11 th -13 th Sept. 2025	1 st IA Test of Regular V & VII Sems. (On 01 CO)
September-2025	13 th Sept. 2025	1 st Feedback on T & L of Regular V & VII Sems.
Sun Mon Tue Wed Thu Fri Sat	15 th Sept. 2025	Commencement of Regular III Sem of AY: 2024-25
7 8 9 10 11 12 13	15 th Sept. 2025	National Engineer's Day (NSS)
14 15 16 17 18 19 20	16 th Sept. 2025	Display of 1 st IA Test Marks of V & VII Sems.
21 22 23 24 25 26 27	26 th -27 th Sept. 2025	1 st Lab IA Test for Regular V & VII Sems. (On 02 COs/5 Expts)
1 st LH: Shri Math Mahadasoha (Tentative)	30 th Sept. 2025	III Sem Welcome-Function & Inauguration of Dept. Association Activities
5 th GH: Ed-Milad (Teachers, Day)	11 th Oct. 2025	Academic Audit of AY:2024-25 by (Odd & Even)
21 st GH: Mahalaya Amavasya	16 th Sept. 2025	Display of 2 nd IA Test & CCAs Marks of Regular V & VII Sems., and 1 st IA Test Marks of Regular III Sem.
October -2025	23 rd -25 th Oct. 2025	2 nd IA Test & CCAs of Regular V & VII Sems. (On 02 COs) and 1 st IA Test of Regular III Sem. (On 01 CO)
Sun Mon Tue Wed Thu Fri Sat	25 th Oct. 2025	2 nd Feedback on T & L of V & VII Sems., and 1 st Feedback on T&L of Regular III Sem
5 6 7 8 9 10 11	21 st -22 nd Nov. 2025	Final Lab IA Test for Regular V & VII Sems., on remaining 03 COs/5 Expts and 1 st Lab IA Test for Regular V & VII Sems. (On 03 COs/5 Expts)
12 13 14 15 16 17 18	24 th Nov. 2025	Project Exhibition (Mini & Major) (Dept. Associations)
19 20 21 22 23 24 25	26 th Nov. 2025	Constitution Day (NSS)
26 27 28 29 30 31	27 th -29 th Nov. 2025	3 rd IA Test & CCAs of Regular V & VII Sems. (On 02 COs) and 2 nd IA Test & CCAs of Regular III Sem. (On 02 COs)
1 st -2 nd GH: Mahanavami/Ayudh Pooja, Vijay Dashami & Gandhi Jayanti on 2 nd	29 th Nov. 2025	2 nd Feedback on T&L of Regular III Sem
7 th GH: Maharshi Valmiki Jayanti	2 nd Dec. 2025	Display of 3 rd IA Test & CCAs Marks of Regular V & VII Sems. and 2 nd IA Test & CCAs Marks of Regular III Sem.
20 th GH: Narak Chaturdashi	4 th Dec. 2025	Last Working Day of Regular V & VII Sems.
22 nd GH: Balipadyami, Deepavali	6 th Dec.25.-3 rd Jan. 26	VTU Theory Examinations of Regular V & VII Sem.
November -2025	9 th Dec. 2025	Anti-Corruption Day (NSS)
Sun Mon Tue Wed Thu Fri Sat	13 th Dec. 2025	Blood Donation Camp & Health Check-up Camp (YRC & NSS)
30	26 th -27 th Dec. 2025	Indoor Sports Competitions (By Sports & Yoga Dept.)
2 3 4 5 6 7 8	29 th -30 th Dec. 2025	Alumni Association Activity
9 10 11 12 13 14 15	1 st -2 nd Jan. 2026	Final Lab IA Test for Regular III Sem., on remaining 02 COs/5 Expts)
16 17 18 19 20 21 22	4 th -10 th Jan. 2026	VTU Practical /Viva Examinations of Regular V & VII Sem.
23 24 25 26 27 28 29	5 th -7 th Jan. 2026	Tentative 3 rd IA Test & CCAs of Regular III Sem. (On 02 COs)
1 st GH: Kannada Rajyotsava	9 th Jan. 2026	Display of 3 rd IA Test & CCAs Marks of Regular III Sem.
8 th GH: Kanakdas Jayanti	12 th Jan. 2026	National Youth Day (NSS)
December -2025	12 th Jan. 2026	Commencement of Regular VI & VIII Sems.
Sun Mon Tue Wed Thu Fri Sat	Special Note	
1 2 3 4 5 6	As per the VTU Circular, Week End Holiday for every 1 st & 3 rd Saturday and remaining Saturdays are full working days	
7 8 9 10 11 12 13	T&L: Teaching & Learning Process, GH: General Holiday, LH: Local Holiday, CCA: Continuous Comprehensive Assessments, CO: Course Outcome	
14 15 16 17 18 19 20	NSS: National Service Scheme, WEC: Women Empowerment Cell, YRC: Youth Red-Cross	
21 22 23 24 25 26 27		
28 29 30 31		
25 th GH: Christmas		
January -2026		
Sun Mon Tue Wed Thu Fri Sat		
4 5 6 7 8 9 10		
11 12 13 14 15 16 17		
18 19 20 21 22 23 24		
25 26 27 28 29 30 31		
14 th GH: Makar Sankranti (Tentative)		
26 th GH: Republic Day (NSS)		

Dr.S.N.Popannavar
IQAC Coordinator & Dean (Academics)Nidasoshi, Tal: Hukkeri, Dist: Belgaum, Karnataka - 591 236
Phone:+91-8333-278887, Fax:278886, Web: www.hsit.ac.in, Mail: principal@hsit.ac.inDr.S.C.Kamate
Principal

Page 1 of 2



SJP NTrust's

Hirasugar Institute of Technology, Nidasoshi*Inculcating Values, Promoting Prosperity*

Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi

Recognized under 2(f) & 12B of UGC Act, 1956

Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE

EEE Dept.

Academic

Course Plan

2025-26
(Odd Sem)**5.0****Dept. Calendar of Events**

		S J P N Trust's Hirasugar Institute of Technology, Nidasoshi. Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956 Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE		EEE																																																																																																																															
				CoE																																																																																																																															
				AY: 2025-26 (Odd)																																																																																																																															
				Rev. 00																																																																																																																															
DEPARTMENT OF ELECTRICAL & ELCTRONICS ENGG. CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2025-26 (Odd)																																																																																																																																			
Calendar August -2025 <table><tr><td>Sun</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr><tr><td>31</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> 15th GH: Independence Day 18th LH: Shravan Last Monday 27th GH: Varasidhi Vinayaka Vratsha							Sun	Mon	Tue	Wed	Thu	Fri	Sat	31					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	Date Events & Holidays <table><tr><td>4th Aug. 2025</td><td>Commencement of Regular V & VII and Summer Semester Classes for Registered Courses (Ref.2)</td></tr><tr><td>20th Aug. 2025</td><td>Technical Talk</td></tr><tr><td>23rd Aug. 2025</td><td>Ideathon & Project Synopsis Presentation (Mini & Major)</td></tr><tr><td>11th -13th Sept. 2025</td><td>1stIA Testof Regular V & VII Sems. (On 01 CO)</td></tr><tr><td>13th Sept. 2025</td><td>1stFeedback on T & L of Regular V & VII Sems.</td></tr><tr><td>15th Sept. 2025</td><td>Commencement of Regular III Sem of AY: 2025-26</td></tr><tr><td>15th Sept. 2025</td><td>National Engineer's Day (NSS)</td></tr><tr><td>16th Sept. 2025</td><td>Display of 1st IA Test Marks of V & VII Sems.</td></tr><tr><td>26th -27th Sept. 2025</td><td>1st Lab IA Test for Regular V & VII Sems. (On 02 COs/5 Expts)</td></tr><tr><td>30th Sept. 2025</td><td>III Sem Welcome-Function & Inauguration of Dept. Association Activities</td></tr><tr><td>11th Oct 2025</td><td>Cooking without fire & clay modeling</td></tr><tr><td>11th Oct. 2025</td><td>Academic Audit of AY:2024-25 by (Odd & Even)</td></tr><tr><td>16th Oct. 2025</td><td>Display of 2nd IA Test& CCAs Marks of Regular V & VII Sems., and 1st IA Test Marks of Regular III Sem.</td></tr><tr><td>23rd -25th Oct. 2025</td><td>2ndIA Test& CCAs of Regular V & VII Sems. (On 02 COs) and 1st IA Test of Regular III Sem. (On 01 CO)</td></tr><tr><td>25th Oct. 2025</td><td>2ndFeedback on T & L of V & VII Sems., and 1st Feedback on T&L of Regular III Sem</td></tr><tr><td>4th Nov. 2025</td><td>Parents-Teacher Meet</td></tr><tr><td>21st -22nd Nov. 2025</td><td>Final Lab IA Test for Regular V & VII Sems., on remaining 03 COs/5 Expts) and 1st Lab IA Test for Regular V & VII Sems. (On 03 COs/5 Expts)</td></tr><tr><td>24th Nov. 2025</td><td>Project Exhibition (Mini & Major) (Dept. Associations)</td></tr><tr><td>26th Nov. 2025</td><td>Constitution Day (NSS)</td></tr><tr><td>27th -29th Nov. 2025</td><td>3rdIA Test& CCAs of Regular V & VII Sems. (On 02 COs) and 2nd IA Test & CCAs of Regular III Sem. (On 02 COs)</td></tr><tr><td>29th Nov. 2025</td><td>2nd Feedback on T&L of Regular III Sem</td></tr><tr><td>2nd Dec. 2025</td><td>Display of 3rd IA Test& CCAs Marks of Regular V & VII Sems. and 2nd IA Test& CCAs Marks of Regular III Sem.</td></tr><tr><td>4th Dec. 2025</td><td>Last Working Day of Regular V & VII Sems.</td></tr><tr><td>6th Dec.25-3rd Jan. 26</td><td>VTU Theory Examinations of Regular V & VII Sem.</td></tr><tr><td>9th Dec. 2025</td><td>Anti-Corruption Day (NSS)</td></tr><tr><td>13th Dec. 2025</td><td>Industrial Visit</td></tr><tr><td>13th Dec. 2025</td><td>Blood Donation Camp & Health Check-up Camp (YRC & NSS)</td></tr><tr><td>26th -27th Dec. 2025</td><td>Indoor Sports Competitions (By Sports & Yoga Dept.)</td></tr><tr><td>29th -30th Dec. 2025</td><td>Alumni Association Activity</td></tr><tr><td>1st -2nd Jan. 2026</td><td>Final Lab IA Test for Regular III Sem., on remaining 02 COs/5 Expts)</td></tr><tr><td>4th -10th Jan. 2026</td><td>VTU Practical /Viva Examinations of Regular V & VII Sem.</td></tr><tr><td>5th -7th Jan. 2026</td><td>Tentative 3rd IA Test & CCAs of Regular III Sem. (On 02 COs)</td></tr><tr><td>9th Jan. 2026</td><td>Display of 3rd IA Test& CCAs Marks of Regular III Sem.</td></tr><tr><td>12th Jan. 2026</td><td>National Youth Day (NSS)</td></tr><tr><td>12th Jan. 2026</td><td>Commencement of Regular VI & VIII Sems.</td></tr><tr><td colspan="2">Special Note</td></tr><tr><td colspan="2">As per the VTU Circular, Week End Holiday for every 1st & 3rd Saturday and remaining Saturdays are full working days</td></tr><tr><td colspan="2">T&L: Teaching & Learning Process, GH: General Holiday, LH: Local Holiday, CCA: Continuous Comprehensive Assessments, CO: Course Outcome NSS: National Service Scheme, WEC: Women Empowerment Cell, YRC: Youth Red-Cross</td></tr></table>							4 th Aug. 2025	Commencement of Regular V & VII and Summer Semester Classes for Registered Courses (Ref.2)	20 th Aug. 2025	Technical Talk	23 rd Aug. 2025	Ideathon & Project Synopsis Presentation (Mini & Major)	11 th -13 th Sept. 2025	1 st IA Testof Regular V & VII Sems. (On 01 CO)	13 th Sept. 2025	1 st Feedback on T & L of Regular V & VII Sems.	15 th Sept. 2025	Commencement of Regular III Sem of AY: 2025-26	15 th Sept. 2025	National Engineer's Day (NSS)	16 th Sept. 2025	Display of 1 st IA Test Marks of V & VII Sems.	26 th -27 th Sept. 2025	1 st Lab IA Test for Regular V & VII Sems. (On 02 COs/5 Expts)	30 th Sept. 2025	III Sem Welcome-Function & Inauguration of Dept. Association Activities	11 th Oct 2025	Cooking without fire & clay modeling	11 th Oct. 2025	Academic Audit of AY:2024-25 by (Odd & Even)	16 th Oct. 2025	Display of 2 nd IA Test& CCAs Marks of Regular V & VII Sems., and 1 st IA Test Marks of Regular III Sem.	23 rd -25 th Oct. 2025	2 nd IA Test& CCAs of Regular V & VII Sems. (On 02 COs) and 1 st IA Test of Regular III Sem. (On 01 CO)	25 th Oct. 2025	2 nd Feedback on T & L of V & VII Sems., and 1 st Feedback on T&L of Regular III Sem	4 th Nov. 2025	Parents-Teacher Meet	21 st -22 nd Nov. 2025	Final Lab IA Test for Regular V & VII Sems., on remaining 03 COs/5 Expts) and 1 st Lab IA Test for Regular V & VII Sems. (On 03 COs/5 Expts)	24 th Nov. 2025	Project Exhibition (Mini & Major) (Dept. Associations)	26 th Nov. 2025	Constitution Day (NSS)	27 th -29 th Nov. 2025	3 rd IA Test& CCAs of Regular V & VII Sems. (On 02 COs) and 2 nd IA Test & CCAs of Regular III Sem. (On 02 COs)	29 th Nov. 2025	2 nd Feedback on T&L of Regular III Sem	2 nd Dec. 2025	Display of 3 rd IA Test& CCAs Marks of Regular V & VII Sems. and 2 nd IA Test& CCAs Marks of Regular III Sem.	4 th Dec. 2025	Last Working Day of Regular V & VII Sems.	6 th Dec.25-3 rd Jan. 26	VTU Theory Examinations of Regular V & VII Sem.	9 th Dec. 2025	Anti-Corruption Day (NSS)	13 th Dec. 2025	Industrial Visit	13 th Dec. 2025	Blood Donation Camp & Health Check-up Camp (YRC & NSS)	26 th -27 th Dec. 2025	Indoor Sports Competitions (By Sports & Yoga Dept.)	29 th -30 th Dec. 2025	Alumni Association Activity	1 st -2 nd Jan. 2026	Final Lab IA Test for Regular III Sem., on remaining 02 COs/5 Expts)	4 th -10 th Jan. 2026	VTU Practical /Viva Examinations of Regular V & VII Sem.	5 th -7 th Jan. 2026	Tentative 3 rd IA Test & CCAs of Regular III Sem. (On 02 COs)	9 th Jan. 2026	Display of 3 rd IA Test& CCAs Marks of Regular III Sem.	12 th Jan. 2026	National Youth Day (NSS)	12 th Jan. 2026	Commencement of Regular VI & VIII Sems.	Special Note		As per the VTU Circular, Week End Holiday for every 1 st & 3 rd Saturday and remaining Saturdays are full working days		T&L: Teaching & Learning Process, GH: General Holiday, LH: Local Holiday, CCA: Continuous Comprehensive Assessments, CO: Course Outcome NSS: National Service Scheme, WEC: Women Empowerment Cell, YRC: Youth Red-Cross	
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																																																																																																													
31					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																																																																																																																													
4 th Aug. 2025	Commencement of Regular V & VII and Summer Semester Classes for Registered Courses (Ref.2)																																																																																																																																		
20 th Aug. 2025	Technical Talk																																																																																																																																		
23 rd Aug. 2025	Ideathon & Project Synopsis Presentation (Mini & Major)																																																																																																																																		
11 th -13 th Sept. 2025	1 st IA Testof Regular V & VII Sems. (On 01 CO)																																																																																																																																		
13 th Sept. 2025	1 st Feedback on T & L of Regular V & VII Sems.																																																																																																																																		
15 th Sept. 2025	Commencement of Regular III Sem of AY: 2025-26																																																																																																																																		
15 th Sept. 2025	National Engineer's Day (NSS)																																																																																																																																		
16 th Sept. 2025	Display of 1 st IA Test Marks of V & VII Sems.																																																																																																																																		
26 th -27 th Sept. 2025	1 st Lab IA Test for Regular V & VII Sems. (On 02 COs/5 Expts)																																																																																																																																		
30 th Sept. 2025	III Sem Welcome-Function & Inauguration of Dept. Association Activities																																																																																																																																		
11 th Oct 2025	Cooking without fire & clay modeling																																																																																																																																		
11 th Oct. 2025	Academic Audit of AY:2024-25 by (Odd & Even)																																																																																																																																		
16 th Oct. 2025	Display of 2 nd IA Test& CCAs Marks of Regular V & VII Sems., and 1 st IA Test Marks of Regular III Sem.																																																																																																																																		
23 rd -25 th Oct. 2025	2 nd IA Test& CCAs of Regular V & VII Sems. (On 02 COs) and 1 st IA Test of Regular III Sem. (On 01 CO)																																																																																																																																		
25 th Oct. 2025	2 nd Feedback on T & L of V & VII Sems., and 1 st Feedback on T&L of Regular III Sem																																																																																																																																		
4 th Nov. 2025	Parents-Teacher Meet																																																																																																																																		
21 st -22 nd Nov. 2025	Final Lab IA Test for Regular V & VII Sems., on remaining 03 COs/5 Expts) and 1 st Lab IA Test for Regular V & VII Sems. (On 03 COs/5 Expts)																																																																																																																																		
24 th Nov. 2025	Project Exhibition (Mini & Major) (Dept. Associations)																																																																																																																																		
26 th Nov. 2025	Constitution Day (NSS)																																																																																																																																		
27 th -29 th Nov. 2025	3 rd IA Test& CCAs of Regular V & VII Sems. (On 02 COs) and 2 nd IA Test & CCAs of Regular III Sem. (On 02 COs)																																																																																																																																		
29 th Nov. 2025	2 nd Feedback on T&L of Regular III Sem																																																																																																																																		
2 nd Dec. 2025	Display of 3 rd IA Test& CCAs Marks of Regular V & VII Sems. and 2 nd IA Test& CCAs Marks of Regular III Sem.																																																																																																																																		
4 th Dec. 2025	Last Working Day of Regular V & VII Sems.																																																																																																																																		
6 th Dec.25-3 rd Jan. 26	VTU Theory Examinations of Regular V & VII Sem.																																																																																																																																		
9 th Dec. 2025	Anti-Corruption Day (NSS)																																																																																																																																		
13 th Dec. 2025	Industrial Visit																																																																																																																																		
13 th Dec. 2025	Blood Donation Camp & Health Check-up Camp (YRC & NSS)																																																																																																																																		
26 th -27 th Dec. 2025	Indoor Sports Competitions (By Sports & Yoga Dept.)																																																																																																																																		
29 th -30 th Dec. 2025	Alumni Association Activity																																																																																																																																		
1 st -2 nd Jan. 2026	Final Lab IA Test for Regular III Sem., on remaining 02 COs/5 Expts)																																																																																																																																		
4 th -10 th Jan. 2026	VTU Practical /Viva Examinations of Regular V & VII Sem.																																																																																																																																		
5 th -7 th Jan. 2026	Tentative 3 rd IA Test & CCAs of Regular III Sem. (On 02 COs)																																																																																																																																		
9 th Jan. 2026	Display of 3 rd IA Test& CCAs Marks of Regular III Sem.																																																																																																																																		
12 th Jan. 2026	National Youth Day (NSS)																																																																																																																																		
12 th Jan. 2026	Commencement of Regular VI & VIII Sems.																																																																																																																																		
Special Note																																																																																																																																			
As per the VTU Circular, Week End Holiday for every 1 st & 3 rd Saturday and remaining Saturdays are full working days																																																																																																																																			
T&L: Teaching & Learning Process, GH: General Holiday, LH: Local Holiday, CCA: Continuous Comprehensive Assessments, CO: Course Outcome NSS: National Service Scheme, WEC: Women Empowerment Cell, YRC: Youth Red-Cross																																																																																																																																			
September-2025 <table><tr><td>Sun</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr><tr><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr><tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td></tr><tr><td>28</td><td>29</td><td>30</td><td></td><td></td><td></td><td></td></tr></table> 1st LH: Shri Math Mahadasoha 5th GH: Ed-Milad (Teachers, Day) 21st GH: Mahalaya Amavasya							Sun	Mon	Tue	Wed	Thu	Fri	Sat		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					October -2025 <table><tr><td>Sun</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr><tr><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr><tr><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr><tr><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td></tr><tr><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td></td></tr></table> 1st -2nd GH: Mahanavami/ Ayudh Pooja Vijay Dashami & Gandhi Jayanti on 2nd 7th GH: Maharshi Valmiki Jayanti 20th GH: Narak Chaturdashi 22nd GH: Balipadyami, Deepavali							Sun	Mon	Tue	Wed	Thu	Fri	Sat				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31																																			
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																																																																																																													
	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																																																																																																																																	
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																																																																																																													
			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																																																																																																																														
November -2025 <table><tr><td>Sun</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr><tr><td>30</td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr><tr><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr><tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td></tr><tr><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td></tr></table> 1st GH: Kannada Rajyotsava 8th GH: Kanakdas Jayanti							Sun	Mon	Tue	Wed	Thu	Fri	Sat	30						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	December -2025 <table><tr><td>Sun</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr><tr><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr><tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td></tr><tr><td>28</td><td>29</td><td>30</td><td>31</td><td></td><td></td><td></td></tr></table> 25th GH: Christmas							Sun	Mon	Tue	Wed	Thu	Fri	Sat		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31																																					
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																																																																																																													
30						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																																																																																																																													
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																																																																																																													
	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																																																																																																																																
January -2026 <table><tr><td>Sun</td><td>Mon</td><td>Tue</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</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> 14th GH: Makar Sankranti (Tentative) 26th GH: Republic Day (NSS)							Sun	Mon	Tue	Wed	Thu	Fri	Sat					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31																																																																																			
Sun	Mon	Tue	Wed	Thu	Fri	Sat																																																																																																																													
				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																																																																																																																													

 Shri. O. B. Heddurshetti
 EESSA Coordinator

 Dr. B. V. Madiggond
 HOD

 Dr. S. C. Kamate
 Principal

 Nidasoshi, Tq: Hukkeri, Dist: Belgaum, Karnataka -591236
 Phone:+91-8333-278887,Fax:278886,Web: www.hsit.ac.in,Mail: principal@hsit.ac.in

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Electrical & Electronics Engineering**Scheme of Teaching and Examinations 2022**

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

III SEMESTER

III SEMESTER													
Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question and Answer Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	BEE301	Engineering Mathematics for EEE	Maths	3	0	0		03	50	50	100	3
2	IPCC	BEE302	Electric Circuit Analysis	EEE	3	0	2		03	50	50	100	4
3	IPCC	BEE303	Analog Electronic Circuits	EEE	3	0	2		03	50	50	100	4
4	PCC	BEE304	Transformers and Generators	EEE	3	0	0		03	50	50	100	3
5	PCCL	BEEL305	Transformers and Generators lab	EEE	0	0	2		03	50	50	100	1
6	ESC	BEE306x	ESC/ETC/PLC	EEE	3	0	0		03	50	50	100	3
7	UHV	BSCK307	Social Connect and Responsibility	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	BEE358x	Ability Enhancement Course/Skill Enhancement Course - III	EEE	If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
					0	0	2						
9	MC	BNSK359	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK359	Yoga	Yoga Teacher									
Total									550	350	900	20	

PCC: Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course (Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

Engineering Science Course (ESC/ETC/PLC)			
BEE306A	Digital Logic Circuits	BEE306C	Electromagnetic Field Theory
BEE306B	Electrical Measurements and Instrumentation	BEE306D	Physics of Electronic Devices
Ability Enhancement Course – III			
BEEL358A	SCI LAB/MATLAB for Transformers and Generators	BEEL358B	555 IC Laboratory
BEEL358C	Circuit Laboratory using P Spice	BEEL358D	Electrical Hardware Laboratory
Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be referred. National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.			



**Course Plan 2025-26 Odd– Semester -3rd
Electrical and Electronics Engineering**

Subject Title	Mathematics-III for EE Engineering		
Subject Code	BMATE301	IA Marks	50
Number of Lecture Hrs / Week	04	Exam Marks	50
Total Number of Lecture Hrs	40	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:

Name: Prof. S.S.Thabaj	Designation: Asst. Professor	Experience: 13
No. of times course taught: 02		Specialization: Mathematics

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Difference equations and Z- Transforms.
- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non-periodic functions to periodic functions using the Fourier series and Fourier transforms. Analyze signals in terms of Fourier transforms.
- Develop the knowledge of solving differential equations and their applications in ECE.
- To find the association between attributes and the correlation between two variables

3.0 Course Outcomes

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

Course Code	Course Outcome	RBTL	POs
C201.1	Understand that physical systems can be described by differential equations and solve such equations.	L1,L2,L3	1,2,3, 12
C201.2	Make use of correlation and regression analysis to fit a suitable mathematical model for statistical data.	L1,L2,L3	1,2,3,12
C201.3	Demonstrate the Fourier series to study the behavior of periodic functions and their Applications in system communications, digital signal processing, and field theory.	L1,L2,L3	1,2,3,12
C201.4	To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations.	L1,L2,L3	1,2,3,12
C201.5	Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field. Demonstrate the validity of testing the hypothesis.	L1,L2,L3	1,2,3,12
Total Hours of instruction		40	



4.0 Course Content

Module-1: Ordinary Differential Equations of Higher Order

Importance of higher-order ordinary differential equations in Electrical & Electronics Engineering applications.

Higher-order linear ODEs with constant coefficients - Inverse differential operator, problems. Linear differential equations with variable Coefficients-Cauchy's and Legendre's differential equations - Problems.

Applications: Application of linear differential equations to L-C circuit and L-C-R circuit. **(8 hours)**

Module -2: Curve fitting, Correlation, and Regressions

Principles of least squares, Curve fitting by the method of least squares in the form $y = a + bx$, $y = a + bx + cx^2$, and $y = ax^b$. Correlation, Coefficient of correlation, Lines of regression, Angle between regressions lines, standard error of estimate, rank correlation. **(8 hours)**

Module -3: Fourier series and practical harmonic analysis:

Periodic functions, Dirichlet's condition. Fourier series expansion of functions with period 2π and with arbitrary period: periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave. Half-range Fourier series. Triangle and half range expansions, Practical harmonic analysis, variation of periodic current. **(8 hours)**

Module -4: Infinite Fourier Transforms and Z Transforms :

Infinite Fourier transforms, Fourier cosine and sine transforms, Inverse Fourier transforms, Inverse Fourier cosine and sine transforms, discrete Fourier transform (DFT), Fast Fourier transform (FFT).

Z Transforms :

Definition, Z-transforms of basic sequences and standard functions. Properties: Linearity, scaling, first and second shifting, multiplication by n . Initial and final value theorem. Inverse Z- transforms. Application to difference equations **(8 hours)**

Module -5: Probability distributions :

Review of basic probability theory, Random variables-discrete and continuous Probability distribution function, cumulative distribution function, Mathematical Expectation, mean and variance, Binomial, Poisson, Exponential and Normal distribution (without proofs for mean and SD)-Problems.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Student's t -distribution, Chi-square distribution as a test of goodness of fit. **(8 hours)**

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	Fourier series is that very little information is lost from the signal during the transformation. The Fourier transform maintains information on amplitude, harmonics, and phase and uses all parts of the waveform to translate the signal into the frequency domain.
02	Z-transform is used in Image processing and Filters, p-n junction, High-pass, low-pass, band-pass filters. Blur removal etc.



7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Differential equations

8.0 Books Used and Recommended to Students

Text Books

1. B.S. Grewal: “Higher Engineering Mathematics”, 44th Edition 2021, Khanna Publishers.
2. E. Kreyszig: “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Ed., 2018.

Reference Books

1. V. Ramana: “Higher Engineering Mathematics” McGraw-Hill Education, 11th Ed. 2017
2. Srimanta Pal & Subodh C. Bhunia: “Engineering Mathematics” Oxford University Press, 3rd, 2016.
3. N.P Bali and Manish Goyal: “A textbook of Engineering Mathematics” Laxmi Publications, 10th Ed., 2016.
4. C. Ray Wylie, Louis C. Barrett: “Advanced Engineering Mathematics” McGraw – Hill Book Co. New York, 6th Ed., 2017.
5. Gupta C.B, Sing S.R and Mukesh Kumar: “Engineering Mathematic for Semester I and II”, McGraw Hill Education (India) Pvt. Ltd 2015.
6. H. K. Dass and Er. Rajnish Verma: “Higher Engineering Mathematics” S. Chand Publication 3rd Ed., 2014.
7. James Stewart: “Calculus” Cengage publications, 7th Ed., 2019.

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

Website and Internet Contents References

Web links and Video Lectures:

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

10.0 Magazines/Journals Used and Recommended to Students

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

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in



the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. There are 25 marks for the CIE's Assignment component and 25 for the IA Test component.
2. Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the Coverage of the syllabus and the second test will be administered after 85-90% of the coverage of The syllabus. The average of the two tests shall be scaled down to 25 marks.
3. Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
4. The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled time table, with common question papers for the course (**duration 03 hours**).

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

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecturer	% of Portion
1	1	Ordinary differential equations (ODE's) of higher order: Introduction, Definition of Ordinary Differential Equation	20
	2	Second order linear ODE's with constant coefficients	
	3	Inverse differential operators	
	4	Problems	
	5	Cauchy's homogeneous equations- Problems	
	6	Legendre homogeneous equations- Problems	
	7	Applications of LDE's to L C and LCR circuits	
	8	Problems	
2	9	Curve fitting, Correlation, and Regressions : Introduction, Principles of least squares,	20
	10	Curve fitting by the method of least squares in the form $y = a + bx$ - Problems	
	11	Curve fitting of the form $y = a + bx + cx^2$ - Problems	
	12	Curve fitting of the form $y = ax^b$ - Problems	
	13	Correlation, Coefficient of correlation- Problems	
	14	Lines of regression, Angle between regression lines- Problems	
	15	Standard error of estimate- Problems	
	16	Rank correlation- Problems	



3	17	Fourier series and practical harmonic analysis: Introduction, Periodic functions, Dirichlet's conditions	20
	18	Fourier series of periodic functions of period 2π and with arbitrary period	
	19	Periodic rectangular wave, Half-wave rectifier	
	20	Rectangular pulse, Saw tooth wave	
	21	Half-range Fourier series	
	22	Triangle and half range expansions	
	23	Practical harmonic analysis	
	24	Variation of periodic current	
4	25	Fourier Transforms : Introduction, Infinite Fourier transform	20
	26	Fourier sine and cosine transforms & Problems	
	27	Problems	
	28	Inverse FT, Fourier cosine & sine transforms-Problems	
	29	Z-Transforms : Introduction, Definition, Z-transforms of basic sequences	
	30	Standard z-transforms , Damping & Shifting rule- Problems	
	31	Inverse z-transform- Problems	
	32	applications to solve difference equations	
5	33	Probability distributions: Introduction, Random variables (discrete & continuous)	20
	34	Probability mass/density functions	
	35	Mathematical expectation, mean and variance..	
	36	Binomial distribution- derivations for mean and SD	
	37	Poisson distribution- derivations for mean and SD	
	38	Exponential distribution.	
	39	Normal distributions- Problems	
	40	Problems	

13.0 Assignments

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1,2&3 of the syllabus	6	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 4, &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: Ordinary differential equations (ODE's) of higher order:

1. Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + a^2y = \sec ax$
2. Solve by the method of variation of parameters $y'' - 6y' + 9y = e^{3x}/x^2$
3. Solve $\frac{d^2y}{dx^2} - 2 \frac{dy}{dx} = e^x \sin x$
4. Solve $\frac{d^2y}{dx^2} + y = \frac{1}{1+\sin x}$



5. Solve $x \frac{d^2y}{dx^2} - 2 \frac{y}{x} = \frac{x+1}{x^2}$.
6. Solve $x^3 \frac{d^3y}{dx^3} + 3x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + 8y = 65 \cos(\log x)$
7. Solve $x^3 \frac{d^3y}{dx^3} + 2x^2 \frac{d^2y}{dx^2} + 2y = 10\left(\frac{x+1}{x}\right)$.
8. Solve $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = \log x \sin(\log x)$
9. Solve $(2x+3)^2 \frac{d^2y}{dx^2} - (2x+3) \frac{dy}{dx} - 12y = 6x$
10. Solve $(1+x)^2 \frac{d^2y}{dx^2} + (1+x) \frac{dy}{dx} + y = \sin[2 \log(1+x)]$.
11. Solve: $\frac{d^2y}{dx^2} + 4 \frac{dy}{dx} + 5y = -2 \cosh x$. Also find y when $y = 0, \frac{dy}{dx} = 1$ at $x = 0$.
12. Solve: $\frac{d^3y}{dx^3} + 2 \frac{d^2y}{dx^2} + \frac{dy}{dx} = e^{-x} + \sin 2x$.
13. Solve: $(D^2 - 4D + 3)y = \sin 3x \cos 2x$.
14. Solve $(D^2 + 1)^2 y = x^4 + 2 \sin x \cos 3x$.
15. Solve: $\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} + y = e^{2x} - \cos 2x$.
16. Solve $(D^3 - D)y = 2x + 1 + 4 \cos x + 2e^x$
17. Solve: $\frac{d^2y}{dx^2} + -4y = \cosh(2x-1) + 3^x$.
18. Solve: $(D^4 - 1)y = e^x \cos x$.
19. Solve: $((D^2 - 4D + 4)y = 8x^2 + \sin 2x$
20. Solve: $((D^2 + a^2)y = \tan ax$.
21. Solve $y'' + 2y' + y = \frac{\log x}{e^x}$ by method of variation of parameter.
22. Solve: $\frac{dx}{dt} + y = \sin t, \frac{dy}{dx} + x = \cos t$; given that $x = 2$ & $y = 0$ when $t = 0$.
23. A body weighing 10 kg is hung from a spring. A pull of 20 kg. wt. will stretch the spring to 10 cm. The body is pulled down to 20 cm below the static equilibrium position and then released. Find the displacement of the body from its equilibrium position at time t sec., the maximum velocity and the period of oscillation.
24. A spring of negligible weight which stretches 1 inch under tension of 2 lb is fixed at one end and is attached to a weight of w lb at the other. It is found that resonance occurs when an axial periodic force $2 \cos 2t$ lb acts on the weight. Show that when the free vibrations have died out, the forced vibrations are given by $x = ct \sin 2t$, and find the values of w and c .
25. In an LCR circuit, the charge q on a plate of a condenser is given by $L \frac{d^2q}{dt^2} + R \frac{dq}{dt} + \frac{q}{C} = E \sin pt$. The circuit is tuned to resonance so that $p^2 = \frac{1}{LC}$. If initially the current i and the charge q be zero, show that, for small values of R/L , the current in the circuit at time t is given by $(Et/2L) \sin pt$.
26. An uncharged condenser of capacity C is charged by applying an e.m.f. $\frac{E \sin t}{\sqrt{LC}}$ through leads of self inductance L and negligible resistance. Prove that at any time t , the charge on one of the plates is $\frac{EC}{2} \left\{ \sin \frac{t}{\sqrt{LC}} - \frac{t}{\sqrt{LC}} \cos \frac{t}{\sqrt{LC}} \right\}$



Module-2: Curve fitting, Correlation, and Regressions :

1. Find the correlation coefficient and regression lines of y and x and x and y for the following data

x	1	2	3	4	5
y	2	5	3	8	7

2. Find the coefficient of correlation for the following data.

x	10	14	18	22	26	30
y	18	12	24	6	30	36

3. Compute the rank correlation coefficient for the following data

x	68	64	75	50	64	80	75	40	55	64
y	62	58	68	45	81	60	68	48	50	70

4. Ten students got the following % of marks in two subjects x and y. Compute their rank correlation coefficient.

Marks in x	78	36	98	25	75	82	90	62	65	39
Marks in y	84	51	91	60	68	62	86	58	53	47

5. Find the equation of the best fitting straight line for the data

x	0	1	2	3	4	5
y	9	8	24	28	26	20

6. A simply supported beam carries a concentrated load p at its midpoint corresponding to various Values of p the maximum deflection y is measured & is given below

p	100	120	140	160	180	200
y	0.45	0.55	0.60	0.70	0.80	0.85

Find the law of the form $y = a + bp$ & hence estimate y when $p = 150$.

7. Fit a second degree parabola of best fit $y = a + bx + cx^2$

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

8. Fit a second degree parabola $y = a + bx + cx^2$ in the least square sense for the following data

x	0	1	2	3	4
y	1	1.8	1.3	2.5	2.3

9. Fit a least square geometric curve $y = ax^b$ from the following data

x	1	2	3	4	5
y	0.5	2.0	4.5	8.0	12.5

10. The voltage v across a capacitor at time t sec is given by the following table

t	0	2	4	6	8
v	150	63	28	12	5.6

Use the method of least square of to fit a curve of the form $v = ax^{bt}$ to this data

Module-3: Fourier series and practical harmonic analysis:

- 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



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

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

7. Obtain Fourier series for the function

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

8. Develop $f(x)$ in Fourier series in the interval $(-2, 2)$ if $f(x) = \begin{cases} 0, & -2 < x < 0 \\ 1, & 0 < x < 2 \end{cases}$

9. Find the half range cosine series for the function $f(x) = x^2$ in the range $0 \leq x \leq 1$

10. Find the complex form of the Fourier series of the periodic function $f(x) = \cos ax$, in $-\pi < x < \pi$.

11. The following table gives the variation of periodic current over a period

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

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

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

13. Obtain the constant term and the coefficient of the first sine and cosine terms in the Fourier expansion of y as given below.

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

Module-4: Infinite Fourier Transforms and Z Transform:

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 $\int_0^\infty \frac{x \sin mx}{1+x^2} dx$.

Z Transform

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



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 $\cos hn\theta$ & $\sin hn\theta$.
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-5: Probability Distributions

1. Find the mean & variance of Binomial distribution.
2. The marks of 1000 students in an examination follows in a normal distribution with mean 70 & SD 5. Find the number of students whose marks will be i) less than 65, ii) more than 75 & iii) between 65 & 75.
3. The probability mass function of a variate X is

X = x _i	-2	-1	0	1	2	3
p(x)	0.1	K	0.2	2k	0.3	k
4. Find i) The value of K, ii) $p(x \leq 0)$, iii) $p(x > 1)$ iv) $p(-2 < x \leq 1)$
5. If 10% of the rivets produced by a machine are defective, find the probability that, out of 12 rivets chosen at random.
6. In a test of 2000 electric bulbs, it was found that the life of a bulb is a normal variable with average life of 2040 hours & standard deviation of 60 hours. Estimate the number of bulbs to burn for i) More than 2150 hours, ii) less than 1950 hours, Given that $p[0 \leq z \leq 1.83] = 0.4664$ & $p[0 \leq z \leq 1.33] = 0.4082$.
7. 2% of the fuses manufactured by a firm are found to be defective. Find the probability that a box containing 200 fuses contains i) no defective fuse, ii) 3 or more defective fuses.
8. In length of a telephone conversation is an exponential variate with mean 3 minutes. Find the probability that call i) ends in less than 3 minutes, ii) takes between 3 to 5 minutes.
9. Suppose that the student IQ scores form a normal distribution with average 100 & standard deviation 20. Find the percentage of students whose (i) score less than 80 (ii) score more than 120 (iii) score falls between 80 & 120 ($G T P(1)=0.3413$)
10. In a certain town the duration of a shower is exponentially distributed with mean 5 minutes what is the probability that a shower will last for i) 10 minutes or more, ii) less than 10 minutes, iii) between 10 min & 12 min
11. The probability that a person aged 60 years will live up to 70 is 0.65. what is the probability that out of 10 persons aged 60 at least 7 of them will live up to 70.



Course Plan 2025-26 Odd– Semester -3rd
Electrical and Electronics Engineering

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



Subject Title	ELECTRIC CIRCUIT ANALYSIS		
Subject Code	BEE302	CIE Marks	50
Number of Lecture Hrs / Week(L:T:P:S)	3:1:6	SEE Marks	50
Total Number of Lecture Hrs	40 hours Theory+ 10Lab slots	Exam Hours	03
Credits-04			

FACULTY DETAILS:			
Name: Dr. B. V. Madiggond	Designation: Professor & HOD	Experience: 32 Years	
No. of times course taught: 02 times		Specialization: Power Electronics	

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

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

3.0 Course Outcomes

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

	Course Outcome	RBT Level	Pos
C202.1	Apply the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network reduction using	L3	1,2,3,5,8,9,12
C202.2	Analyze complex electric circuits using network theorems.	L4	1,2,3,5,8,9,12
C202.3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.	L3	1,2,3,5,8,9,12
C202.4	Develop solutions of electrical network using Laplace transformation.	L4	1,2,3,5,8,9,12
C202.5	Discuss unbalanced three phase systems and also evaluate the performance of two port networks.	L3	1,2,3,5,8,9,12
Total Hours		40	



4.0 Course Content

Module-1

Basic Concepts: Active and passive elements, Concept of ideal and practical sources. 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.

Module-2

Network Theorems: Super Position Theorem, Thevenin's Theorem, Norton's Theorem Maximum power transfer theorem (problems with independent ac and dc sources only).

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 excitations, Behaviour of circuit elements under switching action ($t=0$ & $t=\infty$), Evaluation of initial conditions.

Module-4

Laplace Transformation: Laplace transformation (LT), Initial and Final value theorems. Solution of electrical circuits using LT.

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.

Sl. NO	Experiments
1	Study of the effect of Open and Short circuits in simple circuits.
2	Determination of resonant frequency, bandwidth, and Q of a series circuit.
3	Determination of resonant frequency, bandwidth, and Q of a parallel circuit.
4	Verification of Thevenin's theorem.
5	Verification of Norton's theorem.
6	Verification of Superposition theorem.
7	Verification of Maximum power transfer theorem
8	Power factor correction.
9	Measurement of time constant of an RC circuit.
10	Measurement of power in three phase circuits using two wattmeter method

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	IV	Transmission and Distribution	Transmission line parameters
02	VII	Power system analysis II	Orientation of elements with loops

6.0 Relevance to Real World

Sl.No	Real World Mapping
01	From the electrical wiring in your home that powers the lights and TV, to the ignition system starts car



7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Practical	Simulation of electric networks using software tool

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. Fundamentals of Electric Circuits, Charles K Alexander Matthew N O Sadiku, Mc Graw Hill, 5th Edition, 2013

Reference Books

1. Engineering Circuit Analysis, J David Irwin et al, Wiley India, 10th Edition, 2014
2. Electric Circuits Mahmood Nahvi Mc Graw Hill 5th Edition, 2009
3. Introduction to Electric Circuits, Richard C Dorf and James A Svoboda, Wiley, 9th Edition, 2015
4. Circuit Analysis; Theory and Practice, Allan H Robbins Wilhelm C Miller, Cengage, 5th Edition, 2013

Additional Study material & e-Books

1. Network theory by Ganesh Rao
2. Network analysis by P M Chandrashekaraiyah
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](http://videos.vtu.ac.in/video_groups.php?group=EDUSAT%202016)
- 4) <https://www.docsity.com/en/subjects/electrical-circuit-analysis/>
- 5) <https://sites.google.com/site/eeenotes2u/courses/network-analysis>

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	website
1	IEEE transactions on circuit 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

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

CIE for the theory component of IPCC

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- Three IA tests conducted each of 25 Marks, average of best two IA tests considered and scaled down to 15 marks it will be final IA marks.



- 1st, 2nd, and 3rd tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- Assignments/Seminar/quiz/group discussion /field survey & report presentation/ course project/Skill development activities, suitably planned to attain the COs and POs for a total of 50 Marks.
- One quiz of 25 marks scaled down to 5 marks and one assignment of 25 marks scaled down to 5marks
- Sum of Scaled-down marks of IA tests, one assignments& one quiz will be CIE marks for the theorycomponent of IPCC for 25 marks.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of IPCC

- 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks.
Marks of all experiments write-ups are added and scaled up to 15 marks.
- The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

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

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecture	% of Portion
I	1.	Basic Concepts: Overview and Introduction, Network terminology and classification of electric circuits	20
	2.	Active and passive elements, Concept of ideal and practical sources	
	3.	Derivation of Star – delta, delta– Star transformation.	
	4.	Problems on Star – delta, delta– Star transformation	
	5.	Problem on mesh analysis for dc circuits with independent & dependent sources and concept of super-mesh	
	6.	Problem on nodal analysis for dc circuits with independent &	



		dependent sources and concept of super-mesh	
	7.	Problem on mesh analysis & nodal analysis dc circuits with independent source	
	8.	Problem on Duality	
II	9.	Network Theorems: Super Position Theorem	20
	10.	Problem on Super Position Theorem	
	11.	Thevenin's Theorem	
	12.	Problem on Thevenin's Theorem	
	13.	Norton's Theorem.	
	14.	Problem on Norton's Theorem	
	15.	Maximum power transfer theorem	
	16.	Problem on maximum power transfer theorem	
III	17.	Resonant Circuits: Introduction, Quality factor Analysis of simple series RLC circuits under resonances.	20
	18.	Resonant frequency, Bandwidth, selectivity and Quality factor	
	19.	Problems on Resonant frequency, Bandwidth, selectivity and Quality factor at resonance, Analysis of simple parallel RLC circuits	
	20.	Problems on analysis of simple parallel RLC circuits	
	21.	Transient Analysis: Introduction, general and particular solution, initial condition in basic passive element: Behavior of circuit elements	
	22.	Transient analysis of RL and RC circuits under dc excitations.	
	23.	Problems on transient analysis of RL and RC circuits dc excitations.	
	24.	Problems on transient analysis of RL and RC circuits dc excitations.	
IV	25.	Laplace Transformation: Introduction & Concept of LT	20
	26.	Properties overview	
	27.	Discussion on Initial and final value theorems	
	28.	Problems on LT of normal and standard functions.	
	29.	LT of standard functions.	
	30.	Transform of basic R, L, C elements	
	31.	Solution of electrical circuit using LT with zero initial condition	
	32.	Solution of electrical circuit using LT with initial condition	
V	33.	Unbalanced Three phase systems: Analysis of three phase systems.	20
	34.	Problems on three phase systems.	
	35.	Problems on three phase systems	
	36.	Two Port networks: Introduction and definition	
	37.	Problems Open circuit impedance,	
	38.	Problems on Short circuit admittance	
	39.	Problems on transmission parameters.	
	40.	Evaluation for simple circuits.	

13

Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1	Students study the topics on basic concepts of network theory, Network theorem, Resonant circuits and transient analysis.	Module 1, 2 and 3 of the syllabus	4	Individual Activity.	Books 1 of Text Book list.



2	Quiz	Students study the topics and prepare the multiple choice questioner with answer.	All Modules of the syllabus	9	Group Activity.	Books 1 of Text Book list.
---	------	---	-----------------------------	---	-----------------	----------------------------

14.0 QUESTION BANK

Module 1

1. Define the following i) Active & Passive elements ii) Independent & Dependent source iii) Power & Energy iv) Bilateral & Unilateral elements. v) Linear & Non-linear elements. vi) Ideal & Practical voltage sources. vii) Ideal & Practical current sources.
2. Explain the procedure for solving the given network using i) mesh analysis, ii) node analysis.
3. Obtain the expression for i) 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 10Ω 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 4Ω resistor for the circuit shown in fig 5
17. Find the voltages V_1 , V_2 , V_3 , V_4 and current in 1Ω 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 5Ω 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 $3+j4\Omega$ 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 $R=2\Omega$ in fig 9
13. Find Thevenin equivalent of fig10
14. Using Norton theorem find current in 4Ω resistor in fig 11
15. Find Norton Equivalent of fig12



Module 3

1. What is resonance? What are its types?
2. Explain series resonance? Obtain the condition for resonance
3. Define quality factor and band width & obtain the relationship between them in a series resonance circuit.
4. In case if a series resonant circuit with frequency variation, obtain expression for i) W_c at which maximum voltage occurs across C ii) W_L at which maximum voltage occurs across L & show that $W_L > W_c$
5. Derive the expression for the resonant frequency for a parallel resonance when R_L connected parallel to 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 R_L and R_C 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 at $t=0^+$
23. In the network shown in fig 6.2 the capacitor C_1 is charged to voltage $V_0 = 1000v$ and the switch K is opened at $t=0$. solve for d^2i_z/dt^2 at $t=0^+$
24. The network shown in fig 6.3 has the switch K opened at $t=0$. Solve for v , dv/dt , d^2v/dt^2 at $t=0^+$
25. 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. 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. 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. 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 step 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
i) Y & Z parameters ii) Y & h parameters iii) Y & ABCD parameters iv) Z & h Parameters v) Z & T parameters vi) H & T parameters
3. Two 2port networks are connected in cascade obtain T-parameters of the inter connected network in terms of T parameters of the individual networks.
4. 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.
5. Obtain ABCD parameters in terms of z-parameters and show that $AD-BC = 1$
6. Find the relationship between the z-parameters and h-parameters of a two-port network.
7. Define Z and Y parameters of a 2-port network.
8. Define Z- parameters. Express Z-parameters in terms of Y parameters.
9. Find Z and Y parameters for the two-port network shown in fig.8.1
10. Following are the hybrid parameters of the network given. Define the Y parameters for the network.
$$\begin{matrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{matrix} = \begin{matrix} 5 & 2 \\ 3 & 6 \end{matrix}$$
11. Write explanation on star connected three phase network and delta connected three phase networks.



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

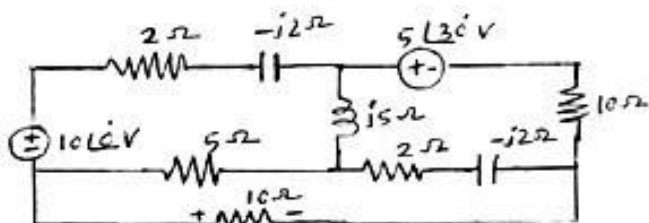


Fig 1.1

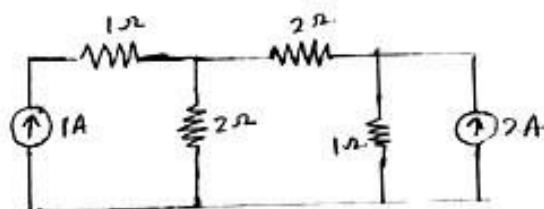


Fig 1.2

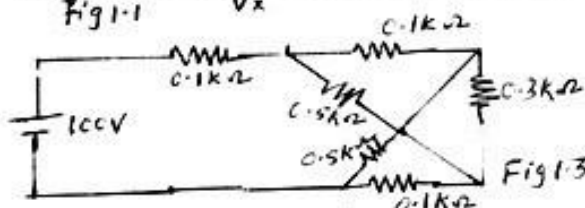


Fig 1.3

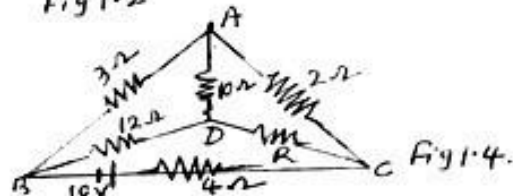


Fig 1.4

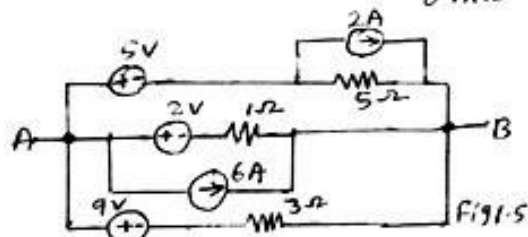


Fig 1.5

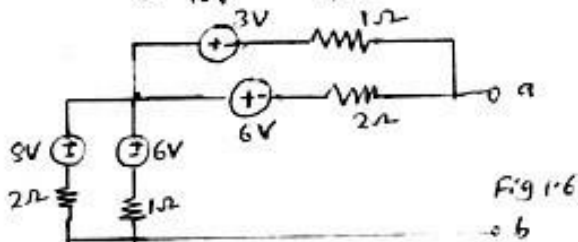


Fig 1.6

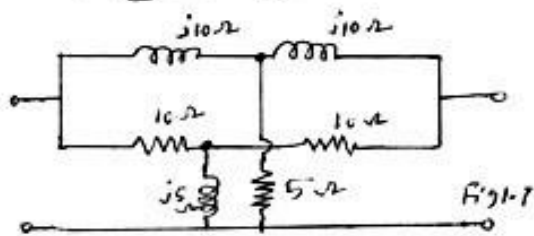


Fig 1.7

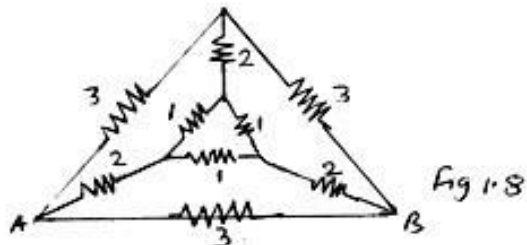


Fig 1.8

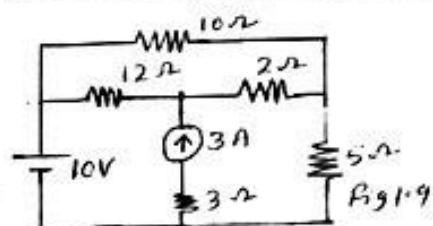


Fig 1.9

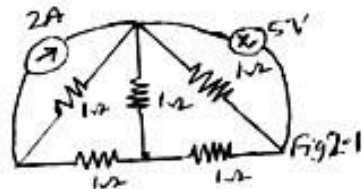


Fig 2.1

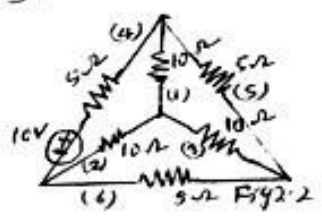


Fig 2.2

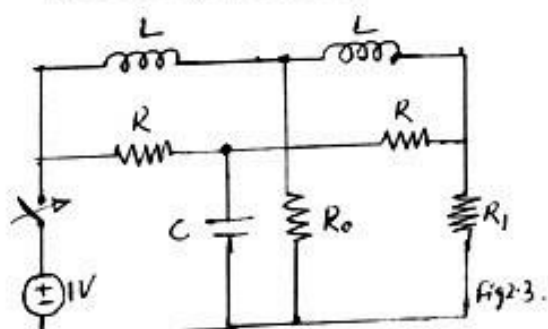


Fig 2.3

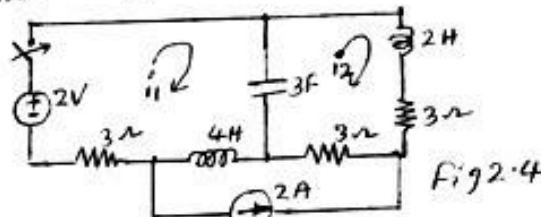


Fig 2.4

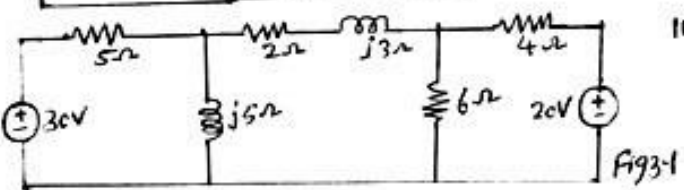


Fig 3.1

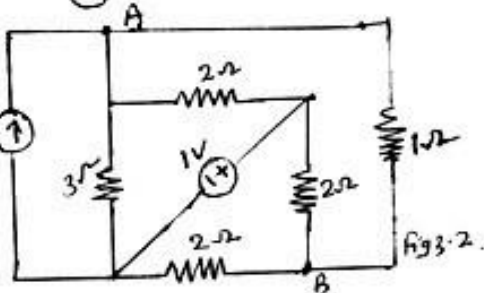


Fig 3.2



Sample circuits for the question bank given (fig 3.3 to 8.1)

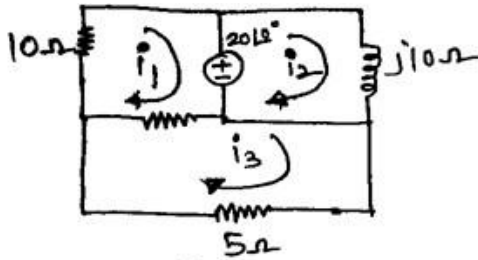


fig 3.3

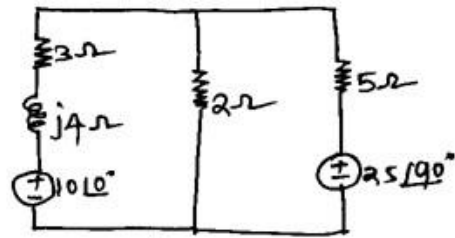


fig 3.4

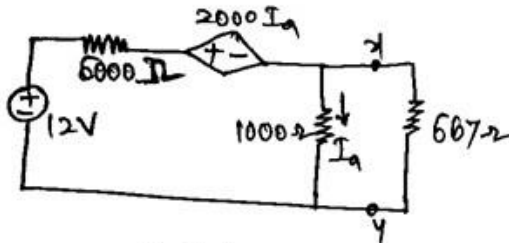


fig 4.1

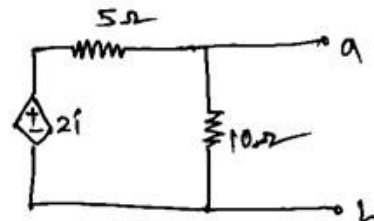


fig 4.2

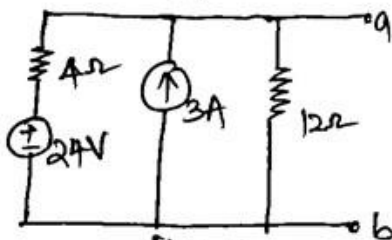


fig 4.3

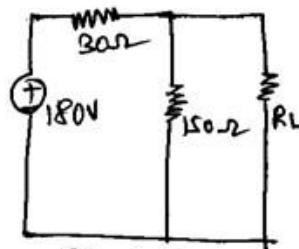


fig 4.4

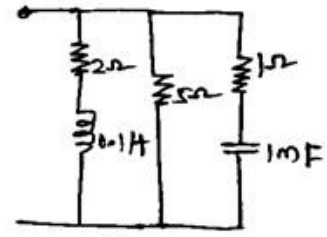


fig 5.1

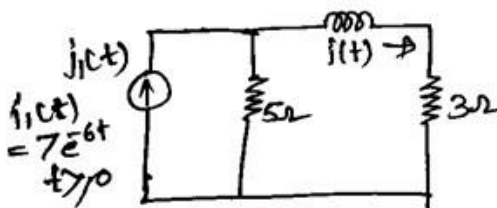


fig 6.2

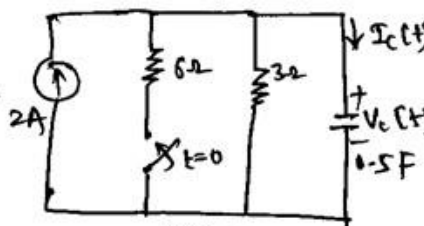


fig 6.1

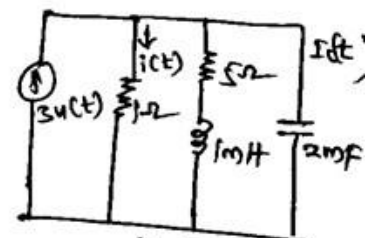


fig 6.3

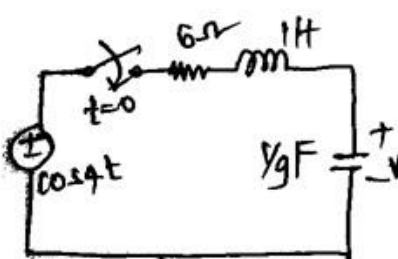


fig 7.1

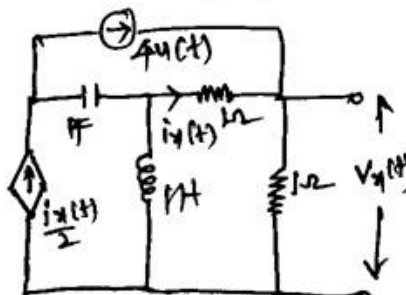


fig 7.2

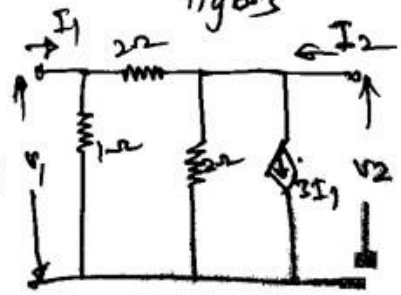
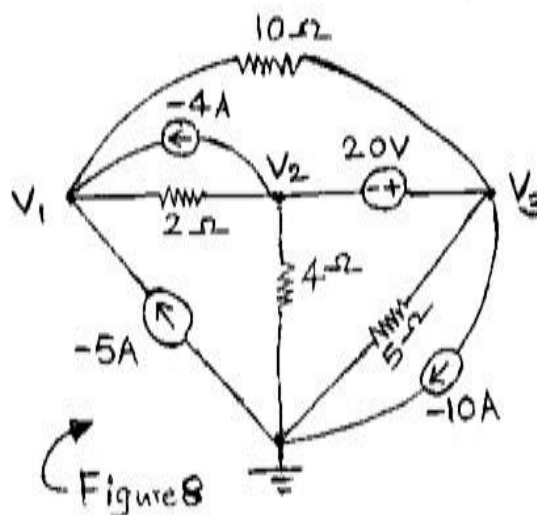
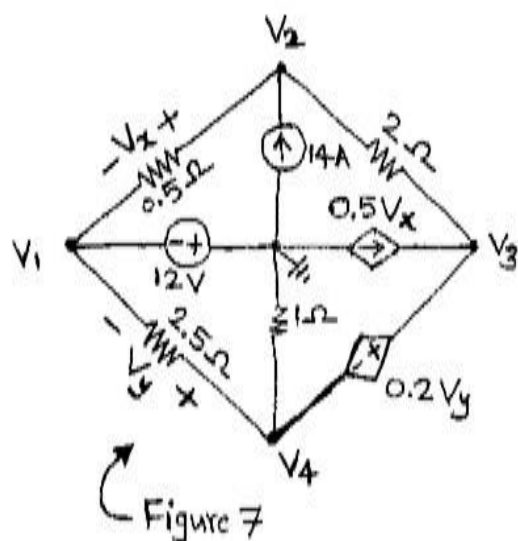
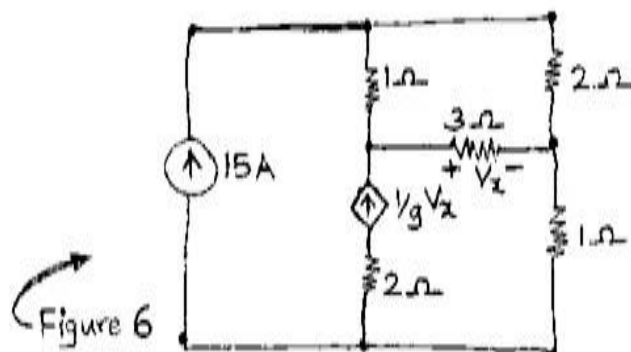
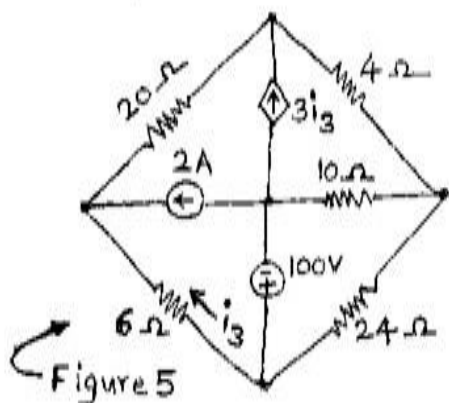
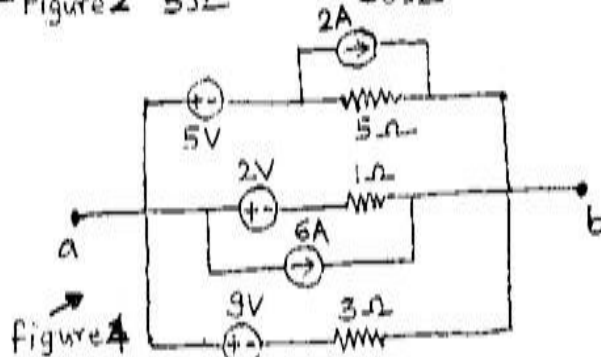
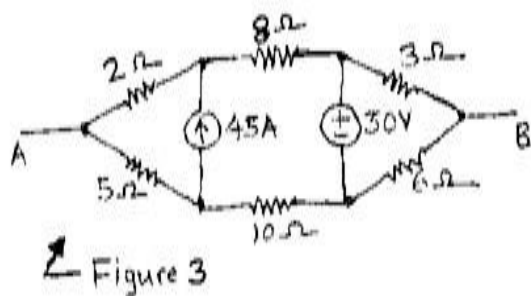
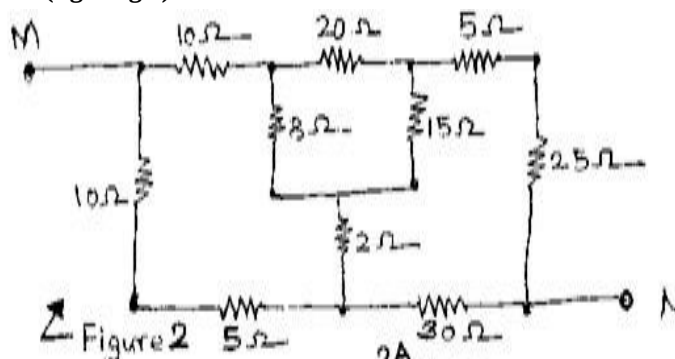
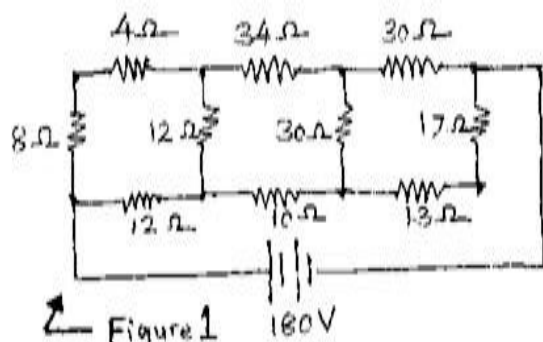


Fig 8.1



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





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

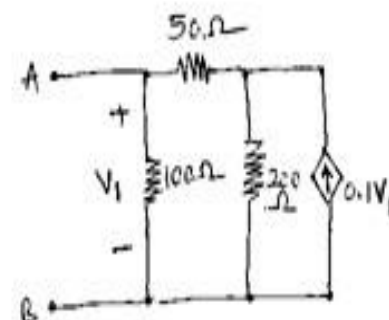
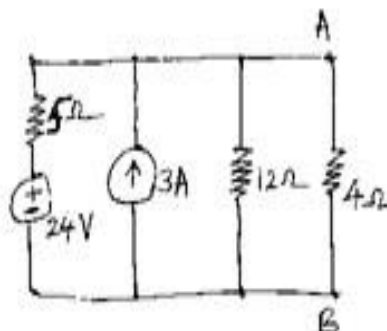
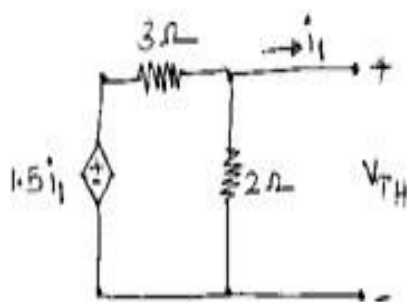
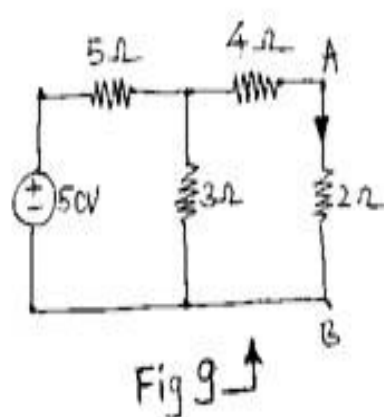
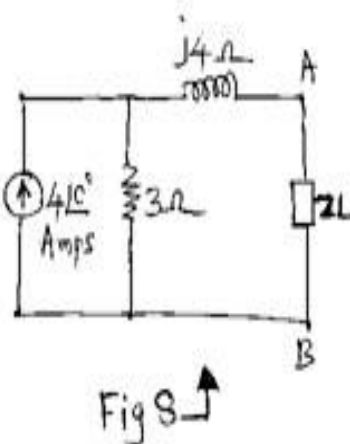
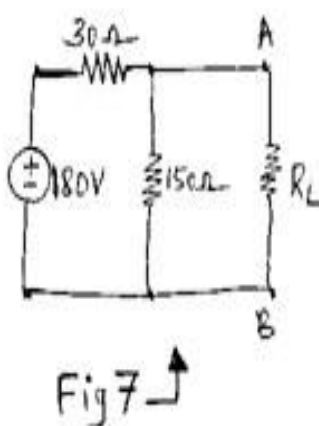
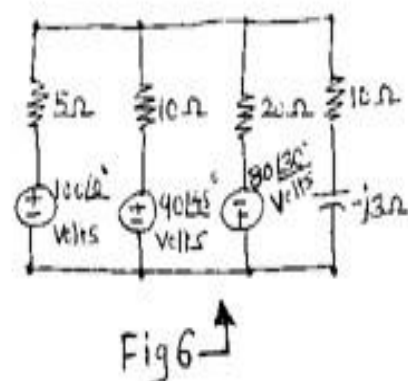
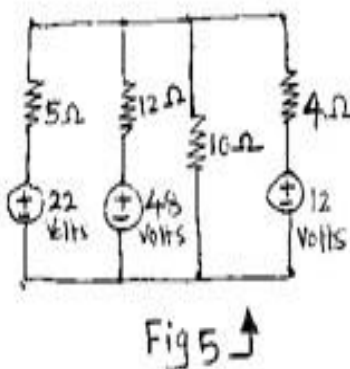
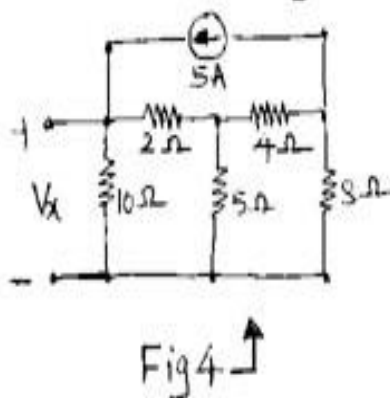
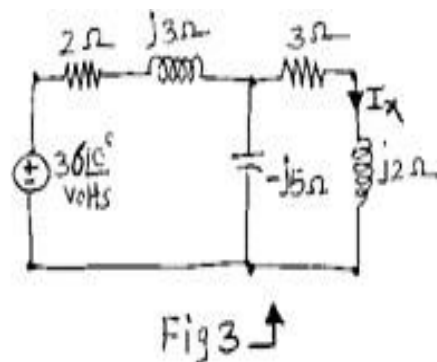
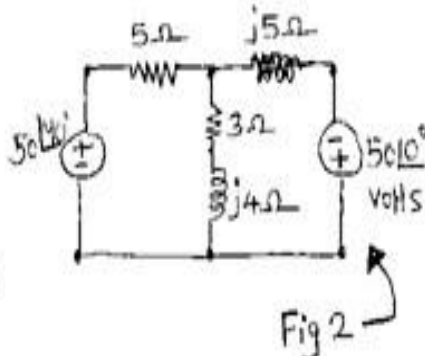
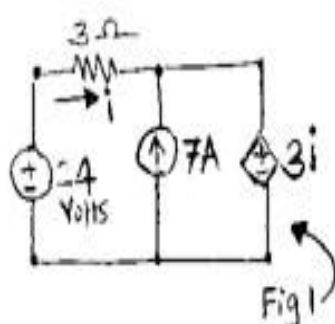
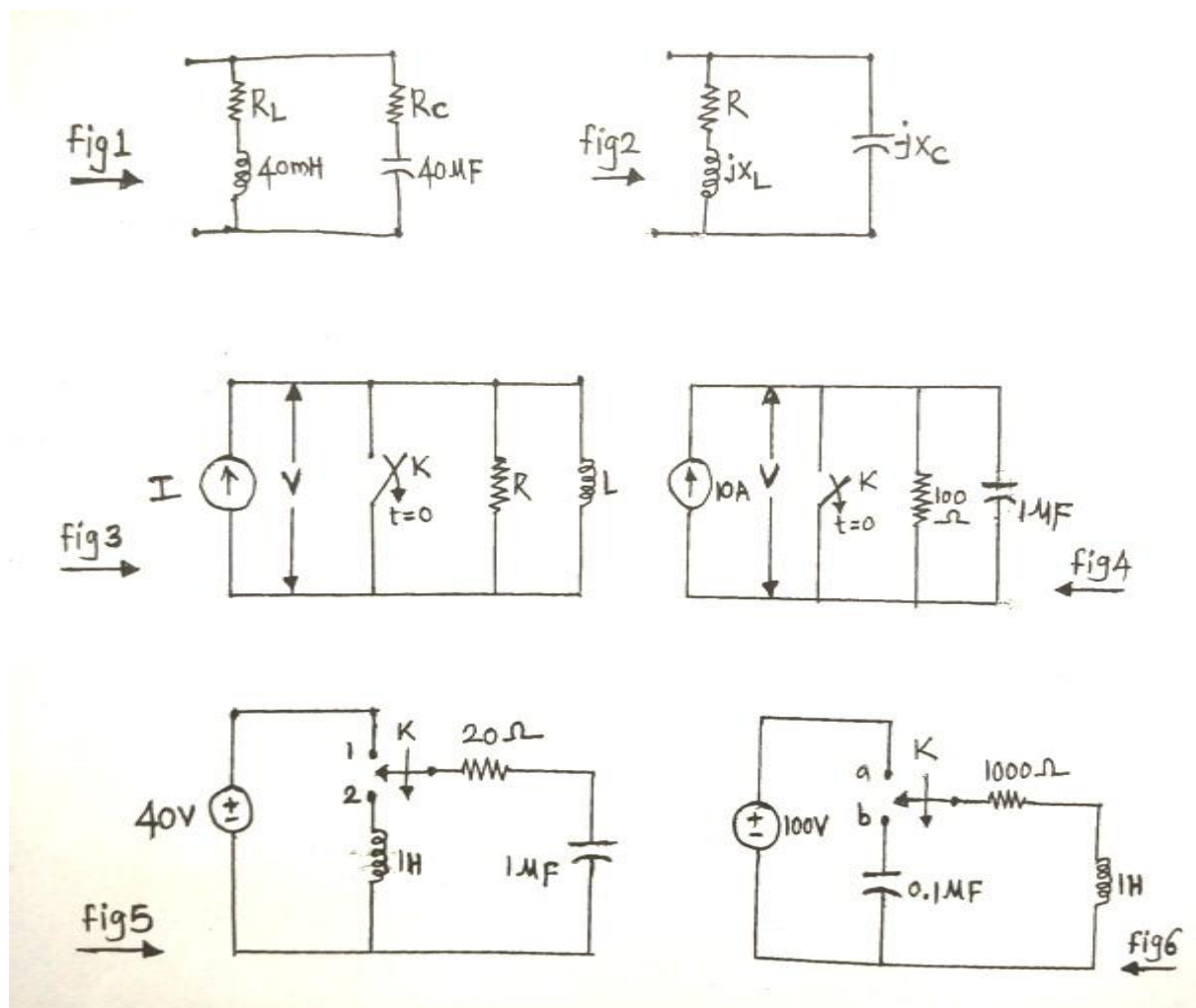


Fig 10 Fig11 Fig 12



Sample networks on resonance, transient analysis



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



Subject Title	ANALOG ELECTRONIC CIRCUITS		
Subject Code	BEE303	CIE Marks	50
Number of Lecture Hrs / Week (L:T:P)	3:1:6	SEE Marks	50
Total Number of Lecture Hrs	40 hours Theory + 10 Lab slots	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:

Name: Shri:Shivanand Hirekodi	Designation: Asst.Professor	Experience: 25
No. of times course taught: 04	Specialization: Power Electronics	

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

1. To provide the knowledge for the analysis of transistor biasing and thermal stability circuits.
2. To develop skills to design the electronic circuits like amplifiers, power amplifiers and oscillators.
3. To understand the importance of FET and MOSFET and FET/MOSFET amplifiers

3.0 Course Outcomes

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

	Course Outcome	RBTL	POs
C203.1	Obtain characteristics of clipper and clamper circuits, design transistor biasing circuits and analyze bias stabilization and stability factors.	L ₁ .L ₃	1,2,3,6,8,9,10,12
C203.2	Analyze transistor amplifier and its frequency response with low frequency signals.	L ₁ -L ₄	1,2,3,6,8,9,10,12
C203.3	Explain concepts of multistage amplifiers and feedback amplifiers.	L ₁ -L ₃	1,2,3,6,8,9,10,12
C203.4	Design and analyze different power amplifier circuits and oscillators.	L ₁ -L ₄	1,2,3,6,8,9,10,12
C203.5	Explain the construction, working, characteristics and biasing of JFET and MOSFET.	L ₁ -L ₃	1,2,3,6,8,9,10,12
Total Hours of instruction		40	



4.0 Course Content

MODULE – 1

Diode Circuits: Diode clipping and clamping circuits.

Transistor Biasing and Stabilization: The operating point, load line analysis, DC analysis and design of fixed bias circuit, emitter stabilized bias circuit, and collector to base bias circuit, voltage divider bias circuit, modified DC bias with voltage feedback. Bias stabilization and stability factors for fixed bias circuit, collector to base bias circuit and voltage divider bias circuit, bias compensation, Transistor switching circuits.

MODULE – 2

Transistor at Low Frequencies:

Hybrid model, h-parameters for CE, CC and CB modes, mid-band analysis of single stage amplifier, simplified hybrid model, analysis for CE, CB and CC(emitter voltage follower circuit) modes, Millers Theorem and its dual, analysis for collector to base bias circuit and CE with un bypassed emitter resistance.

Transistor frequency response:

General frequency considerations, effect of various capacitors on frequency response, Miller effect capacitance, high frequency response, hybrid - pi model, CE short circuit current gain using hybrid pi model, multistage frequency effects.

MODULE - 3

Multistage amplifiers:

Cascade connection, analysis for CE-CC mode, CE-CE mode, CASCODE stage-unbypassed and bypassed emitter resistance modes, Darlington connection using h-parameter model.

Feedback Amplifiers:

Classification of feedback amplifiers, concept of feedback, general characteristics of negative feedback amplifiers, Input and output resistance with feedback of various feedback amplifiers, analysis of different practical feedback amplifier circuits.

MODULE – 4

Power Amplifiers:

Classification of power amplifiers, Analysis of class A, Class B, class C and Class AB amplifiers, Distortion in power amplifiers, second harmonic distortion, harmonic distortion in Class B amplifiers, cross over distortion and elimination of cross over distortion.

Oscillators:

Concept of positive feedback, frequency of oscillation for RC phase oscillator, Wien Bridge oscillator, Tuned oscillator circuits, Hartley oscillator, Colpitt's oscillator, crystal oscillator and its types.

MODULE – 5

FETs:

Construction, working and characteristics of JFET and MOSFET (enhance and Depletion type) Biasing of JFET and MOSFET. Fixed bias configuration, self bias configuration, voltage divider biasing. Analysis and design of JFET (only common source configuration with fixed bias) and MOSFET amplifiers.



Sl. NO	Experiments
1	Experiments on series , shunt and double ended clippers and clampers.
2	Design, simulation 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.
3	Static Transistor characteristics for CE, CB and CC modes and determination of h parameters.
4	Frequency response of single stage BJT and FET RC coupled amplifier and determination of half power points, bandwidth, input and output impedances.
5	Design and testing of BJT -RC phase shift oscillator for given frequency of oscillation.
6	Design, simulation (MATLAB) and testing of Wien bridge oscillator for given frequency of oscillation
7	Design and testing of Hartley and Colpitt's oscillator for given frequency of oscillation
8	Determination of gain, input and output impedance of BJT Darlington emitter follower with and without bootstrapping.
9	Design and testing of Class A and Class B power amplifier and to determine conversion efficiency.
10	Design and simulation of Full wave–centre tapped transformer type and Bridge type rectifier circuits with and without Capacitor filter using MATLAB. Determination of ripple factor, regulation and efficiency.

5.0 Relevance to future subjects

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

6.0 Relevance to Real World

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

7.0 Gap Analysis and Mitigation

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



8.0 Books Used and Recommended to Students

Text Books: Suggested Learning Resources
1. Electronic Devices and Circuit Theory by Robert L Boylestad Louis Nashelsky, Pearson, 11 th Edition, 2015.
2. Electronic Devices and Circuits, Millman and Halkias, Mc Graw Hill, 4th Edition, 2015
3. Electronic Devices and Circuits by David A Bell, Oxford University Press, 5 th Edition, 2008
Reference Books: Suggested Learning Resources
1. Microelectronics Circuits Analysis and Design, Muhammad Rashid, Cengage Learning, 2nd Edition, 2014
2. A Text Book of Electrical Technology, Electronic Devices and Circuits, B.L. Theraja, A.K. Theraja, S. Chand, Reprint, 2013
3. Electronic Devices and Circuits, Anil K. Maini, Vasha Agarwal, Wiley, 1st Edition, 2009
4. Electronic Devices and Circuits, S. Salivahanan, Suresh, Mc Graw Hill, 3rd Edition, 2013
5. Fundamentals of Analog Circuits, Thomas L Floyd, Pearson, 2nd Edition, 2012
Additional Learning Resources
1. Analog Electronic Circuits- a simplified Approach by U.B. Mahadevaswamy Sanguine Technical Publication.

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

Website and Internet Contents References
http://www.nptel.ac.in/ https://www.ti.com/design-development/analog-circuits.html https://www.analog.com/en/education/education-library/tutorials/analog-electronics.html https://en.wikipedia.org/wiki/transistor amplifier https://www.electronicsforu.com

10.0 Magazines/Journals Used and Recommended to Students

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

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.



CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for Internal Assessment Tests (Three Tests, each of 25 Marks with 01-hour duration, are to be conducted and average of best two test marks is taken and scaled down to 15 marks) and 10 marks for other assessment methods like assignment (05 marks) and quiz (05 marks).
- Scaled-down marks of the average of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).
- The student has to secure 40% of 15 marks i.e. 06 marks in CIE- IA tests and 40% of 10 marks i.e. 04 marks in CIE- CCAs (other assessment methods) to qualify in the CIE of the theory component of IPCC.
- The minimum marks to be secured in CIE theory component to appear for SEE shall be 10 (i.e. 40% of maximum marks-25)
- The theory portion of the IPCC shall be for both CIE and SEE

CIE for the practical component of the IPCC

- CIE marks for the practical component is 25 marks.
- 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student has to secure 40% of 15 marks i.e. 06 marks in CIE- practical and 40% of 10 marks i.e. 04 marks in CIE practical test to qualify in the CIE of the practical component of IPCC.
- The minimum marks to be secured in CIE practical component is 10 (i.e. 40% of maximum marks-25)
- Practical portion will have a CIE component only.

SEE for IPCC

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

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Questions mentioned in the SEE paper may include questions from the practical component
5. SEE exam is a theory exam, conducted for 100 marks, scored marked by the student shall be scaled down to 50 Marks.
6. Students have to score minimum 18 marks out of 50 to qualify in SEE.



12.0 Course Delivery Plan

Unit No.	Lecture No.	Content of Lecture	% Portion
1	1.	Diode clipping circuits	20
	2.	Diode clamping circuits	
	3.	Operating point and load line analysis	
	4.	DC analysis and design of fixed bias circuit, emitter stabilized bias circuit.	
	5.	Collector to base bias circuit, voltage divider bias circuit.	
	6.	Bias stabilization and stability factors for fixed bias circuit, collector to base bias.	
	7.	Bias stabilization and stability factors for voltage divider bias circuit, bias compensation.	
	8.	Transistor switching circuits.	
2	9.	Hybrid model, h-parameters for CE, CC and CB modes.	20
	10.	Mid-band analysis of single stage amplifier.	
	11.	Simplified hybrid model, analysis for CE, CB and CC modes	
	12.	Millers Theorem and its dual, analysis for collector to base bias circuit and CE with un bypassed emitter resistance.	
	13.	General frequency considerations, effect of various capacitors on frequency response	
	14.	Miller effect capacitance, high frequency response.	
	15.	Hybrid - pi model.	
	16.	CE short circuit current gain using hybrid pi model, multistage frequency effects.	
3	17.	Cascade connection, analysis for CE-CC mode.	20
	18.	CE-CE mode, CASCODE stage.	
	19.	Unbypassed and bypassed emitter resistance modes.	
	20.	Darlington connection using h-parameter model.	
	21.	Classification of feedback amplifiers, concept of feedback.	
	22.	General characteristics of negative feedback amplifiers.	
	23.	Input and output resistance with feedback of various feedback Amplifiers.	
	24.	Analysis of different practical feedback amplifier circuits.	
4	25.	Classification of power amplifiers, Analysis of class A amplifier.	20
	26.	Analysis of Class B, class C and Class AB amplifiers.	
	27.	Distortion in power amplifiers, second harmonic distortion.	
	28.	Harmonic distortion in Class B amplifiers, cross over distortion and elimination of cross over distortion.	
	29.	Concept of positive feedback, frequency of oscillation for RC phase oscillator.	
	30.	Wien Bridge oscillator.	
	31.	Tuned oscillator circuits, Hartley oscillator.	
	32.	Colpitt's oscillator, crystal oscillator and its types.	
5	33.	Construction, working and characteristics of JFET.	20
	34.	Construction, working and characteristics of MOSFET (Enhancement and Depletion type)	
	35.	Biasing of JFET and MOSFET.	
	36.	Fixed bias configuration.	
	37.	Self bias configuration.	
	38.	Voltage divider biasing.	
	39.	Analysis and design of JFET (only common source configuration with fixed bias)	
	40.	Analysis and design of MOSFET.	



13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1	Students study the topics on diode and transistor circuits, Multi stage and Power amplifiers and feedback circuits. Get practice to solve questions.	Module 1, 2 and 3 of the syllabus	8	Individual Activity.	Books 1-3 of Text Book list.
2	On line Quiz	Students study the topics of all five modules	All Modules of the syllabus	12	Individual Activity.	Books 1-3 of Text Book list.

14.0 QUESTION BANK

MODULE 1

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

MODULE 2

1. Using exact hybrid model of a C-E transistor amplifier, obtain the expressions for current gain, voltage gain, output resistance and input resistance.
2. State and explain Miller's theorem.
3. Obtain an expression in terms of h- parameters for a transistor as a two port network. Using the above developed equations obtain the hybrid model of CE, CC and CB configurations.
4. Derive an expression for voltage gain and current gain of an amplifier circuit using BJT in CE configuration using approximate hybrid model.
5. What are the advantages of h-parameters?
6. A transistor is connected as a common emitter amplifier driving a load of $10\text{K}\Omega$. 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. 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.
8. For voltage series feedback derive expressions for output impedance.

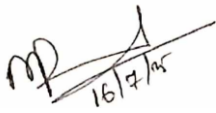
MODULE 4

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 are the conditions for sustained oscillator or what is Barkhausen criterion?
16. What is Oscillator circuit? What are the classifications of Oscillators? What are the conditions for oscillation?
17. Define piezoelectric effect. Draw the equivalent circuit of crystal oscillator.
18. What are sinusoidal oscillators? Explain any two sinusoidal oscillators?
19. Explain the concept involved in crystal oscillator with its characteristics?
20. With the help of a neat circuit diagram, explain transistor Hartley oscillator. Write the expression for the frequency of oscillation.
21. Explain the characteristics of quartz crystal. With a neat diagram explain the oscillator in parallel resonant circuits.
22. Explain the working of RC phase shift oscillator and derive an expression for frequency of oscillation.
23. Draw the Wein bridge oscillator using BJT. Show that the gain of the amplifier must be at least 3 for the oscillations to occur.



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.
6. Determine Z_i , Z_o , and A_i for JFET common source amplifier with fixed bias configuration using AC equivalent small signal model.
7. Derive expressions for V_{gs} , I_d , V_{ds} , V_d and V_s for a voltage divider bias circuit using FET.
8. A JFET has a device parameter of $g_m = 10\text{mS}$, $I_{BSS} = 12\text{mA}$, when the device is suitably biased, the drain current was found to be 8mA . Determine V_p , g_m , V_{gs}

Prepared by	Checked by		
	 16/7/25	 22/7/25	
Prof. S.D.Hirekodi	Prof. M.P.Yenagimath	HOD	Principal



Subject Title	Transformers and Generators		
Subject Code	BEE304	CIE Marks	50
Number of Lecture Hrs / Week	3:0:0:0	SEE Marks	50
Total Number of Lecture Hrs	40	Exam Hours	03
CREDITS – 03			

FACULTY DETAILS:

Name: Prof. Amit U Neshti	Designation: Asst. Professor	Experience: 17 Years
No. of times course taught: 05 (including present)	Specialization: Digital Electronics	

1.0 Prerequisite Subjects:

Sl.No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electrical Engineering
02	Electrical & Electronics Engineering	1/II	Renewable Energy Sources

2.0 Course Objectives

1. To understand the construction, working and various tests of single phase Transformer.
2. To understand the construction, working and parallel operation of three phase Transformer.
3. To understand the construction, working and analysis of Synchronous Generator.
4. To understand the construction, working of solar and wind power generators.
- 5.

3.0 Course Outcomes

Having successfully completed this course, the student will be able

CO	Course Outcome	RBT Level	POs
C204.1	Explain the construction, working and evaluate the performance of single phase Transformer.	L1,L2,L3	PO1,2,3,8,9,12
C204.2	Explain the construction, working, connection types and parallel operation of three phase Transformer and discuss about Autotransformer and Tap changing transformer.	L1,L2,L3	PO 1,2,3,8,9,12
C204.3	Explain the construction, working and analysis of Synchronous Generator and also evaluate the performance of Salient Pole Synchronous Generator.	L1,L2,L3	PO 1,2,3,8,9,12
C204.4	Explain the construction, working and types of wind and solar power generators.	L1,L2	PO 1,2,3,8,9,12
Total Hours of instruction		40	

4.0 Course Content

Module-1

Single phase Transformers:

Necessity of transformer, principle of operation, Types and construction, EMF equation, equivalent circuit, Operation of practical transformer under no-load and on-load with phasor diagrams. Losses and methods of reducing losses, efficiency and condition for maximum efficiency. Polarity test, Sumpner's test. Open circuit and Short circuit tests, calculation of equivalent circuit parameters. Predetermination of efficiency, voltage regulation and its significance. Numerical

Module-2

Three-phase Transformers: Introduction, Constructional features of three-phase transformers. Transformer connection for three phase operation– star/star, delta/delta and star/delta, comparative features. Labelling of three-phase transformer terminals.



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. Numerical.

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

Module-3

Synchronous Generators: Construction, working, Armature windings, winding factors, EMF equation. Harmonics–causes, reduction and elimination. Armature reaction, Synchronous reactance, Equivalent circuit.

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

Module-4

Synchronous Generators (Salient Pole): Effects of saliency, two-reaction theory, Parallel operation of generators and load sharing. Methods of Synchronization, Synchronizing power. 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. Numerical

Module-5

Wind power Generator–Basic components of wind energy conversion system, types of wind generators- Horizontal and vertical axis. Advantages and disadvantages of WECS.

Solar power generator- Principle of solar cell, Basic Solar Photo voltaic, system for power generation, Advantages and disadvantages.

5.0 Relevance to future subjects

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

6.0 Relevance to Real World

SL No	Real World Mapping
01	Power transmission and Distribution
02	Energy-intensive industrial applications

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Lab and industrial visit.	Familiarization of real machine parts and its constructional features. 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, et al, 4th Edition, 2011.
2. Electric Machines, Ashfaq Hussain, Dhanpat Rai & Co, 2nd Edition, 2013.
3. Non conventional Energy sources by G D Rai

Reference Books

1. Electric Machines, Mulukuntla S. Sarma, et al, Cengage, 1st Edition, 2009.
2. Electrical Machines, Drives and Power systems, Theodore Wildi, Pearson, 6th Edition, 2014.
3. Principles of Electrical Machines, V.K Mehta, Rohit Mehta, S Chand, 2nd edition, 2009.

Additional Study material & e-Books

1. Transformers & Generators by Bakshi, Technical publications
2. Electrical Machines M.V. Deshpande PHI Learning 2013
3. Electric Machines R.K. Srivastava Cengage Learning 2nd Edition, 2013
4. Principles of Electric Machines and power Electronics P.C.Sen Wiley 2nd Edition, 2013
5. Electric Machinery and Transformers Bhag S Guru et al Oxford University Press 3rd Edition, 2012
6. Theory of Alternating Current Machines Alexander Langsdorf Mc Graw Hill 2nd Edition, 2001



9.0

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

Website and Internet Contents References

- 1) www.nptel.ac.in
- 2) <http://www.electrical4u.com>
- 3) www.nptel.com
- 4) <https://en.wikipedia.org/wiki/Transformer>
- 5) <https://www.youtube.com/watch?v=LAIPHANefQo>
- 6) www.electrical4u.com/transformer/
- 7) <http://www.electrical4u.com/working-principle-of-dc-generator-and-alternator/>
- 8) www.ijset.net/journal/68.pdf
- 9) www.electrical4u.com/dcgenerator
- 10) www.electrical4u.com/alternator
- 11) www.electrical4u.com/.../alternator
- 12) <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	IPT Magazine	https://www.intelligent-power-today.com/
3	Electric apparatus magazine	https://electricalapparatus.wordpress.com/2016/06/30/electric-generator-up-and-running/
4	E drive magazine	http://www.e-driveonline.com/main/
5	Motor magazine	https://www.motor.com/newsletters/20110410/WebFiles/ID1_IonizingAmerica.html

11.0

Examination Note

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation (CIE):

Three Tests each of 25 Marks;

- 1st, 2nd, and 3rd tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- The average of best two IAs will be considered for the CIE.
- If the nature of the courses requires assignments/Seminars/Quizzes/group discussion, etc, **TWO** evaluation components shall be conducted for 25 Marks each and average of this will be considered for CIE.

Total CIE marks will be 50 marks (IA + CCE)

Semester End Examination (SEE):

Only those students who satisfy the attendance and CIE requirement shall be eligible to appear for the SEE of that course.

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



- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1	1.	Single phase Transformers: Necessity of transformer, principle of operation, Types and construction	20%
	2.	Derivation of EMF equation, equivalent circuit	
	3.	Operation of practical transformer under no-load and on-load with phasor diagrams	
	4.	Losses and methods of reducing losses, efficiency and condition for maximum efficiency	
	5.	Polarity test, Sumpner's test.	
	6.	Open circuit and Short circuit tests, calculation of equivalent circuit parameters.	
	7.	Predetermination of efficiency, voltage regulation and its significance	
	8.	Numericals	
2	9.	Three-phase Transformers: Introduction, Constructional features of three-phase transformers	20%
	10.	Transformer connection for three phase operation– star/star, delta/delta and star/delta, comparative features	
	11.	Labelling of three-phase transformer terminals. Parallel Operation of Transformers	
	12.	Necessity of Parallel operation, conditions for parallel operation– Single phase and three phase.	
	13.	Load sharing in case of similar and dissimilar transformers Numerical.	
	14.	Auto transformers and Tap changing transformers:	
	15.	Introduction to autotransformer-copper economy, equivalent circuit, no load and on load tap changing transformers.	
	16.	Numericals.	
3	17.	Synchronous Generators: Construction, working, Armature windings, winding factors	20%
	18.	EMF equation. Harmonics–causes, reduction and elimination	
	19.	Armature reaction, Synchronous reactance, Equivalent circuit.	
	20.	Synchronous Generators Analysis: Open circuit and short circuit characteristics, Assessment of reactance-short circuit ratio	
	21.	Alternator on load. Voltage regulation.	
	22.	Voltage regulation by EMF and MMF methods	
	23.	Excitation control for constant terminal voltage	
	24.	Numericals.	
4	25.	Synchronous Generators (Salient Pole): Effects of saliency, two-reaction theory	20%
	26.	Parallel operation of generators and load sharing. Methods of Synchronization Synchronizing power	
	27.	Performance of Synchronous Generators	
	28.	Power angle characteristic (salient and non salient pole	
	29.	Power angle diagram, reluctance power	



5	30.	Capability curve for large turbo generators	20%
	31.	Hunting and damper windings	
	32.	Numericals.	
	33.	Wind power Generator – Introduction	
	34.	Basic components of wind energy conversion system	
	35.	Types of wind generators- Horizontal axis wind generators	
	36.	Vertical axis wind generators	
	37.	Advantages and disadvantages of WECS	
	38.	Solar power generator - Principle of solar cell	
	39.	Basic Solar Photo voltaic system for power generation	
	40.	Advantages and disadvantages.	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference book/website /Paper
1.	Assignment 1	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3	10	Individual Activity	Text book no.1
2.	On line Quiz	Students study the topics of all five modules.	All Modules of the syllabus.	12	Individual Activity	Text book no.1

14.0 QUESTION BANK

Module 1

1. Explain with neat sketch the construction of single-phase core type and shell type transformer?
2. Difference between shell and core type transformer?
3. Explain in brief the working principle of single phase transformer.
4. Derive the EMF equation of a transformer.
5. Explain in brief Starting from fundamental develop the exact equivalent circuit and approximate equivalent circuit of a single-phase transformer referred to primary?
6. Draw the phasor diagrams of single-phase transformer with unity pf and lagging pf loads.
7. Draw the phasor diagrams of single-phase transformer with unity pf and lagging pf loads.
8. Explain how the flux in the core of transformer remains constant, from no load to full load. Develop the phasor diagram of an actual transformer when it is inductively loaded.
9. Explain in details OC and SC test (with circuit diagram) for determination of efficiency and regulation of single phase transformer.
10. What are the losses in a transformer? How to reduce these losses? Derive the condition for maximum efficiency? Efficiency and voltage regulation of transformer
11. Define all day efficiency and explain
12. Write a short note on efficiency and voltage regulation of transformer.
13. Discuss the ideal transformer & practical transformer under load and no load.
14. Explain With neat diagram explain in detail Sumpner's test for determining the efficiency and voltage regulation of transformer. Mention its advantages and disadvantages.
15. Explain the separation of hysteresis and eddy current losses in a transformer.

Module 2

1. What is an autotransformer? Discuss merits and demerits of autotransformer?
2. Describe the necessity parallel operation of transformers



3. Explain the Necessary conditions for parallel operation of single phase transformers and then the three phase.
4. Discuss the Load sharing in case of similar and dissimilar transformers.
5. What is an autotransformer? Derive an expression for the saving of copper when an autotransformer is used? Mention its applications?
6. Explain the Necessary conditions for parallel operation of single phase transformers and then the three phase.
7. Explain the classification of polyphase connection of three phase transformer.
8. Discuss the Phase conversion – Scott connection for three-phase to two-phase conversion.
9. Discuss the Labeling of three-phase transformer terminals & vector groups.
10. Discuss the Equivalent circuit of three phase transformers.
11. Discuss the equivalent circuit, three phase autotransformer connection and voltage regulation.
12. Discuss the Voltage regulation by tap changing – off circuit and on load.

Module 3

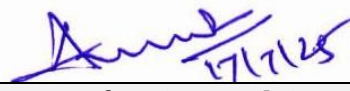
1. Explain the armature reaction in synchronous generators.
2. Draw and explain the equivalent circuit of synchronous generators.
3. Explain the causes & effects of harmonics generated by transformers.
4. List the advantage of stationary armature in synchronous machine.
5. Explain the essential difference between cylindrical and salient pole rotors used in large alternators
6. List the advantage of chording of armature coils in synchronous machine. Derive the expression for pitch factor.
7. Define the breadth factor. Derive expression for it.
8. Derive an equation for EMF induced in an alternator.
9. Discuss open circuit and short circuit characteristics of synchronous generator.
10. Explain MMF or ampere turn's method of finding the Regulation of alternator.
11. Describe the construction and working of synchronous generator.

Module 4

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

Module 5

1. What are the basic components of wind energy conversion system?
2. Discuss the different types of wind generators.
3. Explain the advantages and disadvantages of WECS.
4. Describe the Principle of solar cell.
5. Explain Solar Photo voltaic system for power generation in detail.

Prepared by	Checked by		
			
Prof.Amit U Neshti	Prof.Amit U Neshti	HOD	Principal



Subject Title	TRANSFORMERS AND GENERATORS LAB		
Subject Code	BEEL305	CIE Marks	50
No. of Lecture hrs./Week(L:T:P:S)	0:0:2	SEE Marks	50
		Exam Hours	03
CREDITS – 01			

FACULTY DETAILS:			
Name: Prof. S. J. Patil	Designation: Asst. Professor	Experience: 12 Years	
No. of times course taught: 01 Times		Specialization: Industrial Electronics	

1.0	Prerequisite Subjects:		
Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I	Basic electrical Engineering

2.0	Course Objectives
	➤ To conduct various tests on transformers and synchronous machine and evaluation of their performance. ➤ To perform the parallel operation of two single phase transformers of different KVA rating. ➤ To study and verify the performance of synchronous generator. ➤ To calculate the voltage regulation of an alternator using different methods for comparison.

3.0	Course Outcomes		
------------	------------------------	--	--

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

CO	Course Outcome	RBT Level	POs
C205.1	Conduct various tests on transformer and synchronous machines and evaluate their performance.	L ₁ ,L ₂ ,L ₃	1,2,8,9,10,12
C205.2	Perform the parallel operation on two single phase transformer	L ₁ ,L ₂ ,L ₃	1,2,8,9,10,12
C205.3	Verify the performance of synchronous generator.	L ₁ ,L ₂ ,L ₃	1,2,8, 9,10,12
C205.4	Calculate the voltage regulation of an alternator using different methods for comparison	L ₁ ,L ₂ ,L ₃	1,2,8,9,10,12
Total Hours of instruction			24

4.0	Course Content		
------------	-----------------------	--	--

Experiments

- 1 Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination 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 Separation of hysteresis and eddy current losses in single phase transformer.
- 7 Investigate the voltage and current ratios of a multi-tapped transformer and verify the ideal transformer ratio.
- 8 Voltage regulation of an alternator by EMF and MMF methods.
- 9 Power angle curve of synchronous generator or Direct load test on three phase synchronous generator to determine efficiency and regulation.
- 10 Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice-versa.
- 11 Model transformer in Simscape for Automatic Voltage Regulation.
- 12 Simulate power angle curve of generator in MATLAB.

5.0 Relevance to future subjects

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

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

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation(CIE):

- CIE marks for the practical course are **50 Marks**.
- The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.
- Each experiment is to be evaluated for conduction with an observation sheet and record write-up.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to 20 marks (40% of the maximum marks).

Semester End Evaluation (SEE):

- SEE marks for the practical course are **50 Marks**.
- SEE shall be conducted jointly by the two examiners appointed by the university.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly. Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here,
- Writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks.
- SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.
- The minimum duration of SEE is **02 hours**
-



11.0 Course Delivery Plan

Expt No.	Aim of the Experiment	% of Portion
1.	Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of (i) Efficiency and regulation (ii) Calculation of parameters of equivalent circuit.	8.33
2.	Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.	8.33
3.	Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification of data using Short circuit test data.	8.33
4.	Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.	8.33
5.	Comparison of performance of 3 single-phase transformers in delta –delta and V – V(open delta) connection under load.	8.33
6.	Separation of hysteresis and eddy current losses in single phase transformer.	8.33
7.	Investigate the voltage and current ratios of a multi-tapped transformer and verify the ideal transformer ratio.	8.33
8.	Voltage regulation of an alternator by EMF and MMF methods.	8.33
9.	Power angle curve of synchronous generator or Direct load test on three phase synchronous generator to determine efficiency and regulation.	8.33
10.	Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa.	8.33
11.	Model transformer in Simscape for Automatic Voltage Regulation.	8.33
12.	Simulate power angle curve of generator in MATLAB.	8.33

12.0 QUESTION BANK

1. Define Transformer?
2. Mention different classifications of Transformer?
3. Give the constructional details of the core & winding part of the transformer,
4. Compare core type & shell type transformers.
5. Power transformer are designed to give good
 - a. all day efficiency b) power efficiency
6. Distribution transformer are designed to give good
 - a. all day efficiency b) power efficiency
7. Transformer is “Constant flux Machine” True/False, Justify
8. Give the classification of transformers in details.
9. Draw the phasor diagram for single phase transformer considering,
 - a. Resistive Load b) Inductive Load c) Capacitive Load
10. Draw the Exact & approximate Equivalent Electric Circuit of single phase transformer
11. What do you mean by the term “Voltage Regulation of Transformer?”
12. Give the expression for the Voltage regulation in terms of approximate voltage drop.
13. Give the condition for maximum power efficiency of the transformer, Use the condition to decide the KVA load to be applied on the transformer to give maximum efficiency.
14. Give the comparison between Power efficiency & Energy efficiency.
15. Give the importance of Energy efficiency in case of Distribution Transformer & that of Power efficiency in case of Power transformer.



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

Prepared by	Checked by		
			
Prof. S. J. Patil	Prof. A. U. Neshti	HOD	Principal



Subject Title	555 IC Laboratory		
Subject Code	BEEL358B	CIE Marks	50
No. of Lecture hrs./Week (L:T:P:S)	0:0:2:0	SEE Marks	50
		Exam Hours	02
CREDITS – 01			

FACULTY DETAILS:

Name: Prof. H.R.Zinage	Designation: Asst. Professor	Experience: 24 Years
No. of times course taught: 03 Times		Specialization: Power system

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

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

3.0 Course Outcomes

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

CO	Course Outcome	RBT Level	POs
CO212	Analyze in an intelligent manner, think better, and perform better.	L ₁ ,L ₂ ,L ₃ ,L ₄	PO1-PO12
Total Hours of instruction		24	

4.0 Course Content

Experiments

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

5.0 Relevance to future subjects

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



6.0 Relevance to Real World

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

7.0 Magazines/Journals Used and Recommended to Students

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

8.0 Examination Note

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation (CIE):

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

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

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

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

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

All laboratory experiments are to be included for practical examination.

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



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

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

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

9.0 Course Delivery Plan

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

10.0 QUESTION BANK

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

Prepared by	Checked by		
			
Prof. H. R. Zinage	Dr. M. P. Yenagimath	HOD	Principal



Subject Title	DIGITAL LOGIC CIRCUIT		
Subject Code	BEE306A	CIE Marks	50
Number of Lecture Hrs / Week(L:T:P:S)	3:0:0:0	SEE Marks	50
Total Number of Lecture Hrs	40 hours theory	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:

Name: Prof. P.I. Savadatti	Designation: Asst Professor	Experience: 10
No. of times course taught: 02	Specialization: Digital Electronics	

1.0 Prerequisite Subjects:

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

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
C206.1	Explain the concept of combinational and sequential logic circuits.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C206.2	Analyse and design combinational circuits.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C206.3	Describe and characterize flip flops and its applications.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C206.4	Design the sequential circuits using SR, JK, D and T flip-flops and Melay and Moore applications.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
C206.5	Design applications of combinational and Sequential circuits also employ the digital circuits for different applications.	L1,L2,L3	PO1,PO2,PO3, PO8,PO10,PO12
Total Hours of instruction			40



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 (pulse 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	Project	--

6.0 Relevance to Real World

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

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	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	2002
3	Digital design	M. Morris Mano	Prentice Hall of India	3 rd Edition
4	Fundamentals of logic design	Charles H Roth, JR	Cengage Learning	5 th Edition

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

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

10.0 Magazines/Journals Used and Recommended to Students

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

11.0 Examination Note

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation (CIE):

Three Tests each of 25 Marks;

- 1st, 2nd, and 3rd tests shall be conducted after completion of the syllabus of 30-35%, 70-75%, and 90-100% of the course/s respectively.
- The average of best two IAs will be considered for the CIE.
- If the nature of the courses requires assignments/Seminars/Quizzes/group discussion, etc, **TWO** evaluation components shall be conducted for 25 Marks each and average of this will be considered for CIE.

Total CIE marks will be 50 marks (IA + CCE)



Semester End Examination (SEE):

Only those students who satisfy the attendance and CIE requirement shall be eligible to appear for the SEE of that course.

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

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and marks scored out of 100 shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

12.0 Course Delivery Plan

MODULE	Lect. No.	Content of Lecture	% of Portion
MODULE-1 Principles of Combinational Logic:	1	Introduction & definition of combinational & canonical forms	20
	2	Generation of switching equations from truth tables, Examples	
	3	Karnaughmaps-3, 4 and 5 variables.	
	4	Incompletely specified functions (Don't care terms). examples	
	5	Simplifying Max term equations	
	6	Quine-McCluskey minimization technique	
	7	Quine-McCluskey using don't care terms	
	8	Reduced Prime Implicants table	
MODULE-2 Analysis and Design of Combinational logic	9	General approach to combinational logic design	20
	10	Decoders , BCD decoders	
	11	Encoders	
	12	Digital multiplexers	
	13	using multiplexers as Boolean function generators	
	14	Adders and Subtractors	
	15	Cascading full adders/ lookahead carry	
	16	Binary comparators	
MODULE-3 Flip-Flops	17	Basic Bistable element.	20
	18	Latches	
	19	Timing considerations	
	20	The master-slave Flip-Flop	
	21	SR Flip flops	
	22	JK Flip flops	
	23	Edge triggered flip flops	
	24	Characteristic equations	
MODULE-4 Flip-Flops Applications	25	Registers,	20
	26	Binary Ripple Counter	
	27	Synchronous Binary counters,	
	28	Counters based on Shift Registers	



	29	Design of a synchronous counter,	
	30	Design of a synchronous mod-n counter using clocked T flip-flops.	
	31	JK and D flip flop	
	32	SR flip flops	
MODULE-5 Sequential Circuit Design & Memories:	33	Mealy & Moore model	20
	34	State Machine Notation	
	35	Synchronous Sequential Circuit Analysis	
	36	Construction of state Diagrams	
	37	Counter design.	
	38	Read only and Read/Write Memories,	
	39	Programmable ROM	
	40	EPROM and Flash memory	

13.0 Assignments, Quiz

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/webs ite /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	Quiz	Students will study the topics of all five modules	Modules2-5	13	Individual	Book no 1,2

14.0 QUESTION BANK

MODULE-1

- What is combinational Logic circuit? Explain.
- Write the following minterm canonical formulas in algebraic form and construct truth tables $f(w,x,y,z)=\sum m(1,3,7,8,9,14,15)$
- Explain canonical form of Boolean equations with an example.
- Explain Karnaugh map representation in detail & discuss the merits & demerits.
- Explain the definition of combinational logic circuit.
- Transform each of the following canonical expression in to its other canonical form in decimal notation
 - $f(x,y,z)=\prod M(0,3,4)$
 - $f(x,y,z)=\sum m(1,3,5)$
 - $c(a,b,c,d)=\sum m(1,2,4,6,9,15)$
 - $b.f(w,x,y,z)=\sum m(0,1,2,3,7,9,11,12,15)$
- Express each of the following functions by a Maxterm Canonical formulae
 - $f(x,y,z)=(y+z')(xy'+z)$
 - $f(x,y,z)=x+x'z'(y+z)$
- Using K-maps, determine all the prime implicants of each of the following functions. In each case, indicate the essential prime implicants
 - $f(w,x,y,z)=\sum m(0,1,2,5,6,7,8,9,10,13,14,15)$
 - $f(w,x,y,z)=\prod M(0,2,3,8,9,10,12,14)$
 - $f(w,x,y,z)=w'y'z+w'yz+x'y'z'+wx'y+w'x'yz'$



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.

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) 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:

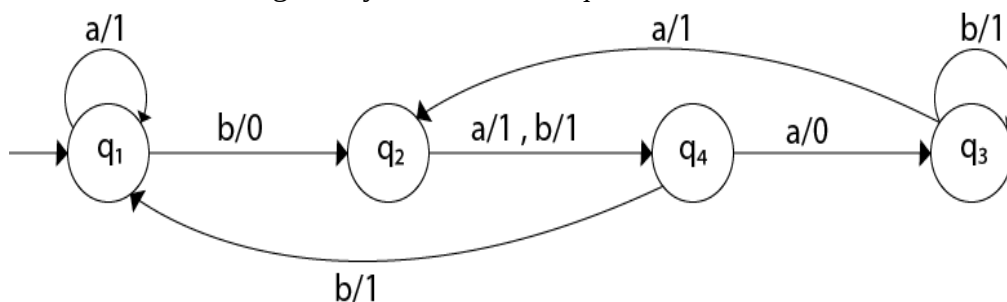
1. Design a switch debouncer using SR and $\bar{S}$ $\bar{R}$ latch.
2. Explain the operation of SR latch.
3. Explain the operation of the master-slave JK f/f and SR f/f along with its circuit diagram.
4. Explain the working of SR f/f by using NOR gates.
5. What is race around condition in f/f? Discuss 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. Write the next state tables and characteristic equations for SR, JK, D and T flip flop.
2. What is a register? Explain with neat diagrams all the types of register.
3. Explain Universal shift register.
4. With a neat logic diagram and timing waveforms explain synchronous binary counters.
5. Design synchronous mod-6 counter using JK and D flip flop.
6. Design a counter that has a repeated sequence of 06 states listed 0→3→4→0→5→6diagram.
7. Design mod-3 counter using JK flip flop. Sketch the waveforms for outputs when clock is applied and verify its operation.

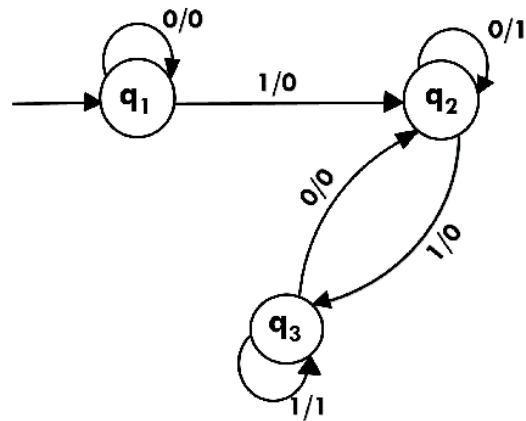
MODULE-5:

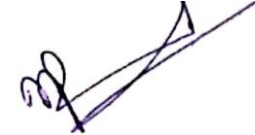
- 1.Explain with neat diagram Mealy machine.
- 2.Explain with neat diagram Moore network.
- 3.Explain different types of sequential networks?
- 4.Convert the following Mealy machine into equivalent Moore machine.





5. Convert the following Mealy machine into equivalent Moore machine.



Prepared by	Checked by		
			
Prof. P. I. Savadatti	Dr. M. P. Yenagimath	HOD	Principal