INSTITUTE VISION

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

INSTITUTE MISSION

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

DEPARTMENT VISION

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

DEPARTMENT MISSION

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

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

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the program will be able to

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

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

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

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs) :

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

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

Contents of VII-SEM

1.0 Student Help Desk

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

2.0 Departmental Resources

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

2.1 Faculty Position

S.N.	Category	No. in position	Average experience
1	Teaching faculty	10	18 Y
2	Technical supporting staff	3	26 Y
3	Helper	2	20 Y

2.2 Major Laboratories

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

3.0 Faculty Details

S.N.	Faculty Name	Designation	Qualification	Area of specialization	Professional membership	Industry Experience (in years)	Teaching Experience (in years)	Contact Nos.
01	Dr. B. V. Madiggond	HOD/Prof.	Ph. D	Power Electronics	LMISTE, YHAI	-	30	9343454993
02	Prof. V. B. Dhere	Asst. Prof.	M. Tech, (Ph. D)	Electronics & Telecommunication	LMISTE, IMPARC	4	26	9886597573
03	Prof. S. D. Hirekodi	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	23	9480849338
04	Prof. H. R. Zinage	Asst. Prof.	M. Tech.	Power System	LMISTE	-	23	9480849335
05	Prof. M. P. Yenagimath	Asst. Prof.	M. Tech (Ph. D)	VLSI & ES	LMISTE	1	17.5	9341449466
06	Prof. O. B. Heddurshetti	Asst. Prof.	M. Tech.	Power Electrics	LMISTE	1	16	9448420509
07	Prof. A. U. Neshti	Asst. Prof.	M. Tech.	Digital Electronics	ISTE	-	15	9538223362
08	Prof. K. B. Neglur	Asst. Prof.	M. Tech.	Industrial Electronics	LMISTE	-	10	9886644507
09	Prof. S. G. Huddar	Asst. Prof.	M. Tech.	Power System Engg.	LMISTE	-	10	9742066852
10	Prof. P. I. Savadatti	Asst. Prof.	M. Tech.	Digital Electronics	-	-	08	9964315436

4.0 Institute Academic Calendar

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 I-11 | AY:2023-24 (Even) | Rev: 01

ACADEMIC CALENDAR OF EVENTS-01 (CoE-01) OF VIII & II SEMs FOR THE AY: 2023-24

Ref: 1) VTU CoE Draft Notification No.: VTU/BGM/AC/2023-24/5699, Dated 16th June 2023
2) VTU CoE Notification No.: VTU/BOS/AC2023-24 (EVEN)/6251, Dated 12th Feb. 2024

February -2024

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		

March -2024

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

April -2024

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				

May-2024

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	

June-2024

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

Date	Events & Holidays
12th Feb. 2024	Commencement of VIII Semester Classes
4th March 2024	National Safety Day
6th March 2024	Commencement of II Semester Classes & Induction Programme ((Phase-2)
8th March 2024	International Women's Day
8th March 2024	GH: Maha-Shivaratri
12th March 2024	NAAC Cycle-02 SSR Submission
13th March 2024	No Smoking Day
15th -16th March 2024	1st IA Test for VIII Sem & Science Day
16th March 2024	1st Feedback on Teaching-Learning (VIII Sem.)
21st March 2024	Display of 1st IA Test Marks of VIII Sem
22nd March 2024	World Water Day
29th March 2024	GH: Good Friday
2nd April 2024	Technovision-24
9th April 2024	GH: Yugadi Festival
11th April 2024	GH: Kutub-A-Ramjan
12th -13th April 2024	2nd IA Test for VIII Sem
13th April 2024	2nd Feedback on Teaching-Learning (VIII Sem.)
15th -17th April 2024	1st IA Test for II Sem
17th April 2024	1st Feedback on Teaching-Learning (II Sem.)
17th April 2024	Display of 2nd IA Test Marks of VIII Sem
22nd April 2024	Display of 1st IA Test Marks of II Sem
1st May 2024	GH: Labours Day
3rd -4th May 2024	Fun Week-HSIT Shambhrama-24 & Graduation day-24
8th May 2024	World Red Cross Day
8th May 2024	3rd IA Test for VIII Sem
9th May 2024	Final Year Project Exhibition
11th May 2024	Display of 3rd IA Test Marks of VIII Sem
10th May 2024	GH: Basav Jayanti/Akhsay Trutiya
11th May 2024	Last Working Day of the VIII Semester Classes
13th -21st May 2024	VIII Sems. VTU Theory Exams
17th-18th May 2024	Lab IA Test-I (II Sem. 2022 Scheme)
20th -22nd May 2024	2nd IA Test for II Sem
22nd May 2024	2nd Feedback on Teaching-Learning (II Sem.)
27th May 2024	Display of 2nd IA Test Marks of II Sem
17th-19th June 2024	3rd IA Test for II Sem
21st -22nd June 2024	Lab IA Test-II (II Sem. 2022 Scheme)
22nd June 2024	Display of 3rd IA Test Marks of II Sem
29th June 2024	Last Working Day of the II Semester Classes
1st -11th July 2024	VTU II Sem Practical Examinations
15th July-10th Aug. 2024	VTU II Sem Theory Examinations

GH: General Holiday, LH: Local Holiday

Dr.S.N.Topannavar
IQAC Coordinator & Dean (Academics)

Dr.S.C.Kamate
Principal

Nidasoshi, Taq: Hukkeri, Dist: Belgaum, Karnataka - 591 236
Phone:+91-8333-278887, Fax:278886, Web:www.hsit.ac.in, Mail:principal@hsit.ac.in

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5.0 Scheme of Teaching & Examination

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

VIII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18EE81	Power System Operation and Control	EEE	3	--	--	03	40	60	100	3
2	PEC	18EE82X	Professional Elective - 4	EEE	3	--	--	03	40	60	100	3
3	Project	18EEP83	Project Work Phase - 2		--	--	2	03	40	60	100	8
4	Seminar	18EES84	Technical Seminar		--	--	2	03	100	--	100	1
5	Internship	18EEI85	Internship	Completed during the vacation/s of VI andVII semesters and /or VII and VIII semesters.)				03	40	60	100	3
			TOTAL		**06**	**--**	**04**	**15**	**260**	**240**	**500**	**18**

Note: PCC: Professional Core, PEC: Professional Elective.

Professional Electives - 4

Course code under 18XX82X	Course Title
18EE821	FACTs and HVDC Transmission
18EE822	Electrical Estimation and Costing
18EE823	**Big Data Analytics in Power Systems**
18EE824	Power System Planning
18EE825	Electrical Power Quality

Project Work

CIE procedure for Project Work Phase - 2:

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

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Project Work Phase - 2:

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

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

Internship: Those, who have not pursued /completed the internship, shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester.In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP(Not Satisfied Activity Points).

Subject Title	**POWER SYSTEM OPERATION &CONTROL**		
Subject Code	18EE81	**CIE Marks**	40
Number of Lecture Hrs / Week	03	**SSE Marks**	60
Total Number of Lecture Hrs	40	**Exam Hours**	03
			CREDITS-3

FACULTY DETAILS:		
Name: Prof. Hemalata R Zinage	**Designation:** Asst. Professor	**Experience:**23
No. of times course taught:11	**Specialization:** Power system	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical &Electronics Engineering	VI	Power system analysis -I
02	Electrical &Electronics Engineering	VII	Power system analysis -II

2.0 Course Objectives

1 To describe various levels of controls in power systems and the vulnerability of the system.
2 To explain components, architecture and configuration of SCADA.
3 To explain basic generator control loops, functions of Automatic generation control, speed governors and mathematical models of Automatic Load Frequency Control
4 To explain automatic generation control, voltage and reactive power control in an interconnected power system.
5 To explain reliability and contingency analysis, state estimation and related issues

3.0 Course Outcomes

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

	Course Outcome	Cognitive Level	POs
C415.1	Describe various levels of controls in power systems, architecture and configuration of SCADA	L3	1,2,3,4,5,8,9,10, 12
C415.2	Develop and analyze mathematical models of Automatic Load Frequency Control.	L3,l4	1,2,3,4,5,8,9,10. 12
C415.3	Develop mathematical model of Automatic Generation Control in Interconnected Power system	L3,L4	1,2,3,4,5,8,9,10, 12
C415.4	Discuss the Control of Voltage , Reactive Power and Voltage collapse	L3,L4	1,2,3,4,5,8,9,10, 12
C415.5	Explain security, contingency analysis, state estimation of power systems	L3,L4	1,2,3,4,5,8,9,10, 12
Total Hours of instruction		**40**	

4.0 Course Content

Module-1

Introduction: Operating States of Power System, Objectives of Control, Key Concepts of Reliable Operation, Preventive and Emergency Controls, Energy Management Centers.

Supervisory Control and Data acquisition (SCADA): Introduction, components, application in Power System, basic functions and advantages. Building blocks of SCADA system, components of RTU, communication subsystem, IED functional block diagram. R2

Classification of SCADA system: Single master–single remote; Single master–multiple RTU; Multiple master–multiple RTUs; and Single master, multiple submaster, multiple remote. R2

Module-2

Automatic Generation Control (AGC): Introduction, Schematic diagram of load frequency and excitation voltage regulators of turbo generators, Load frequency control (Single area case), Turbine speed governing system, Model of speed governing system, Turbine model, Generator load model, Complete block diagram of representation of load frequency control of an isolated power system, Steady state analysis, Control area concept, Proportional plus Integral Controller. T1

Module-3

Automatic Generation Control in Interconnected Power system: Two area load frequency control, Optimal (Two area) load frequency control by state variable, Automatic voltage control, Load frequency control with generation rate constraints (GRCs), Speed governor dead band and its effect on AGC, Digital LF Controllers, Decentralized control. T1

Module-4

Control of Voltage and Reactive Power: Introduction, Generation and absorption of reactive power, Relation between voltage, power and reactive power at a node, Methods of voltage control: i) Injection of reactive power, Shunt capacitors and reactors, Series capacitors, Synchronous compensators, Series injection. ii) Tap changing transformers. Combined use of tap changing transformers and reactive power injection, Booster transformers, Phase shift transformers, Voltage collapse. T3

Module-5

Power System Security: Introduction, Factors affecting power system security, Contingency Analysis, Linear Sensitivity Factors, AC power flow methods, Contingency Selection and Ranking. T2

State estimation of Power Systems: Introduction, Linear Least Square Estimation T2

5.0 Relevance to future subjects

SL No	Semester	Subject	Topics
01	VIII	Project work	SCADA, Automatic Generation Control, Voltage and Reactive Power Control, Power System Reliability and Security

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Model creation for analysis
02	Development of a software applications

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Visit to power plant	Operation of energy control center, SCADA system

8.0 Books Used and Recommended to Students

Text Books
1. Modern Power System Analysis, D. P. Kothari, McGraw Hill, 4 th Edition, 2011
2. Power Generation Operation and Control, Allen J Wood etal, Wiley, 2nd Edition, 2003
3. Electric Power Systems, B M Weedy, B J Cory, Wiley, 4 th Edition, 2012

Reference Books
1. Computer-Aided Power System Analysis, G. L. Kusic, CRC Press, 2nd Edition, 2010
2. Power System SCADA and Smart Grid, Mini S Thom and John D. McDonald, CRC Press, 2015
3. Power System Stability and Control, Kundur, McGraw Hill, 8 th Reprint, 2009
Additional Study material & e-Books
1. Research Papers on Power System Operation and Control published in Journals

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

Website and Internet Contents References
1) *nptel.ac.in/courses/108104052*
2) *freevideolectures.com › Electrical Engineering › IIT Kanpur*
3) *nptel.iitg.ernet.in*

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Explore	***ieeexplore.ieee.org/xpl/RecentIssue***
2	Journalof Modern *Power Systems* and Clean Energy	***www.springer.com***

11.0 Examination Note

SCHEME OF EVALUATION FOR CIE (40 MARKS)

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

Internal Assessment: 50 marks scaled down to 30 marks

Assignment marks: 10 marks.

SCHEME OF EXAMINATION: 100 Marks, scaled down to 60 in VTU result sheet.

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

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
I	1.	**Introduction:** Operating States of Power System, Objectives of Control,	20
	2.	Key Concepts of Reliable Operation Preventive and Emergency Controls, Energy Management Centers	
	3.	**Supervisory Control and Data acquisition (SCADA):** Introduction, components, application in Power System,	
	4.	Basic functions and advantages. Building blocks of SCADA system, components of RTU,	
	5.	Communication subsystem, IED functional block diagram. R2 Single master–multiple RTU;	
	6.	**Classification of SCADA system:** Single master–single remote;	
	7.	Multiple master–multiple RTUs	
	8.	Single master, multiple sub master, multiple remote. R2	
II	9.	**Automatic Generation Control (AGC):** Introduction, Schematic diagram	20

		of load frequency	
	10.	Excitation voltage regulators of turbo generators,	
	11.	Load frequency control (Single area case),	
	12.	Turbine speed governing system,	
	13.	Model of speed governing system, Turbine model, Generator load model,	
	14.	Complete block diagram of representation of load frequency control of an isolated power system,	
	15.	Steady state analysis, Control area concept,	
	16.	Proportional plus Integral Controller. T1	
III	17.	**Automatic Generation Control in Interconnected Power system**:	**20**
	18.	Two area load frequency control,	
	19.	Optimal (Two area) load frequency control by state variable,	
	20.	Automatic voltage control,	
	21.	Load frequency control with generation rate constraints (GRCs),	
	22.	Speed governor dead band and its effect on AGC,	
	23.	Digital LF Controllers,	
	24.	Decentralized control. T1	
IV	25.	**Control of Voltage and Reactive Power:** Introduction, Generation Absorption of reactive power, Relation between voltage, power and reactive power at a node,	**20**
	26.	Methods of voltage control: i) Injection of reactive power,	
	27.	Shunt capacitors and reactors, Series capacitors	
	28.	Synchronous compensators, Series injection.	
	29.	ii) Tap changing transformers.	
	30.	Combined use of tap changing transformers and	
	31.	Reactive power injection,	
	32.	Booster transformers, Phase shift transformers, Voltage collapse. T3	
V	33.	**Power System Security:** Introduction,	**20**
	34.	Factors affecting power system security,	
	35.	Contingency Analysis,	
	36.	Linear Sensitivity Factors,	
	37.	AC power flow methods	
	38.	Contingency Selection and Ranking. T2	
	39.	**State estimation of Power Systems:** Introduction,	
	40.	Linear Least Square Estimation T2	

3.0 Assignments

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Supervisory Control and Data acquisition &Unit Commitment	Students study the Topics and write the Answers. Get practice to solve university questions.	module 1 of the syllabus	2	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list
2	Assignment 2: University Questions on Hydro-thermal Scheduling	Students study the Topics and write the Answers. Get practice to solve university questions.	module2 of the syllabus	4	Individual Activity.	Book 1 of the Text book list. Website of the Reference list
3	Assignment3: University Questions on Automatic Generation Control (continued	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	6	Individual Activity.	Book 1 of the Text book list. Website of the Reference list
4	Assignment4: university Questions Voltage and Reactive Power Control	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4of the syllabus	8	Individual Activity.	Book 1 of the Text book list. Website of the Reference list
5	Assignment5: Power System Reliability and Security & State estimation of Power Systems	Students study the Topics and write the Answers. Get practice to solve university questions.	module5of the syllabus	10	Individual Activity.	Book 3 of the Text book list. Website of the Reference list

14.0 QUESTION BANK

MODULE -1 Introduction to Power System Operation and Control

[1] Explain the Operating states of power system.
[2] Discuss the preventive and emergency controls of power system.
[3] Explain the operation of energy management system.
[4] Explain the SCADA system and its components.
[5] What are the common communication channels for SCADA?
[6] Discuss the challenges for implementation of SCADA.

MODULE-2 Automatic Generation control

[1] Why automatic generation & voltage control is required? Explain.
[2] Explain the objectives and functions of Automatic Generation Control (AGC) in a Power System
[3] Explain the complete block diagram representation of load frequency control of an isolated power system.
[4] Explain how mathematical model of speed governing system is developed for automatic generation control

MODULE-3 Automatic Generation Control in interconnected Power System

[1] Explain the steady state analysis of load frequency control of an isolated system & hence draw the characteristic.
[2] Explain the dynamic state analysis of load frequency control of an isolated power system & hence draw the characteristic.
[3] Show that active power generation is proportional to power command $\Delta P_{c.}$
[4] What is area control error? Explain the advantages of pool operation.
[5] Explain how we can bring frequency deviation will be zero under steady state condition.
[6] With the help of neat block diagram explain the execution of economic dispatch using area control error (ACE) and

base load deviation (BLD)

[7] Explain the parallel operation of alternators.

[8] A 100 MVA synchronous generator operates on full load at frequency of 50 Hz. The load is suddenly reduced to 50MW. Due to time lag in governor system, the steam valve begins to close after 04 seconds. Determine the change in frequency that occurs in this time. Given H= 5Kw-sec/KVA of generator capacity.

[9] Explain with the help of block diagram, the automatic load frequency and voltage regulator loops of a synchronous generator.

[10] Describe the function of AVR with a neat block diagram.

[11] With a neat diagram, explain the brushless AVR loop.

[12] Obtain the brushless excitation modeling & explain the static performance of the brush-less AVR Loop.

[13] Two generators are supplying power to a system, their rating is 50 MW & 500 MW respectively, frequency is 50 Hz and each generator is half loaded. The system load increases by 110 MW and as a result the frequency drops to 49.5 Hz. What must be the individual regulation if the two generators should increase their power in proportion to their rating? (Assuming governor free action and constant B is negligible)

[14] Two generating units rated 200MW and 400MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no load to full load. Assuming that the generators are operating at 50Hz at no load, how would a load of 600MW is shared between them? What will be the system frequency at this load? Assume free governor operation. Repeat the problem if both governors have a droop of 4%.

[15] Two synchronous generators operate in parallel and supply a total load of 200MW. The capacities of the machines are 100MW and 200MW and both have governor droop characteristics of 4% from no load to full load. Calculate the load taken by each machine assuming free governor action.

[16] Two synchronous generators operate in parallel and supply a total load of 400MW. The capacities of the machines are 200MW and 500MW and both have governor droop characteristics of 4% from no load to full load. Calculate the load taken by each machine, assuming free governor action. Also find system frequency at this load.

[17] Two identical 60MW synchronous generators operate in parallel. The governor settings on the machines are such that they have 4% and 3% droops (no load to full load % speed drop).Determine

(a) The load taken by each generator (machine) for a total load of 100MW.

(b) The % adjustment in the no load speed to be made by the speeder motor if the machines are to share the load equally. Assume frequency as 60Hz.

[18] For an isolated single area, consider the following data,

Area capacity, Pr =1000MW

Nominal operating load = P^0_D =500MW

Inertia constant, H= 5Kw-sec/KVA

Regulation = R = 5%

Nominal frequency=f^0 = 50 Hz

Load decreased by 1% for a decrease in frequency by 1%

Find the gain and time constant of power system tube represented with a first order transfer function. Corresponding to a change of load by 50MW, what would be the change in frequency for the system if it is uncontrolled one?

[19] For the single area control system shown in Fig.1, we have following data:

T_p = 10 seconds, T_g= T_t=0, Kp= 100Hz/pu.Mw, D = 3Hz/pu.Mw, ΔP_D = 0.1puMw, K_i = 0.1

Compute the time error caused by a step disturbance of magnitude given above. Prove that the error is reduced by increasing the given K_i. Express the error in seconds and cycle if the system frequency is 50 Hz

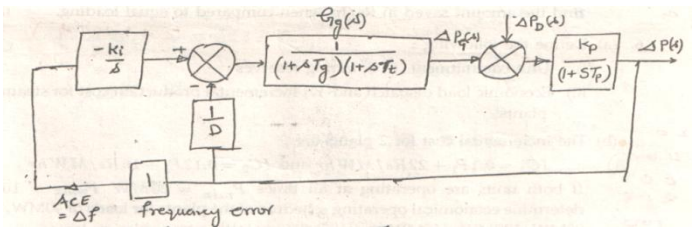

Fig.1

MODULE-4

[5] Describe the various factors affecting the voltage stability and voltage collapse.

[6] What is voltage instability? Explain the phenomenon of voltage collapse with relevant PV and QV diagrams.
[7] What is voltage collapse? Explain with PV and QV characteristics of loads
[8] Explain how the voltage control is achieved by injection of reactive power at nodes
[9] Explain the following methods of the voltage control in a power system:
(i) Injection of capacitive or inductive reactive power.(ii) By tap changing of transformers
[10]. Explain different methods of voltage control.
[11] Describe the control characteristics of an SVC.
[12 Show that the power flow between two nodes is determined by the transmission angle and the flow of reactive power is determined by the scalar voltage difference between the two nodes
[13] A single line diagram for a typical 3 supply points A, B, & C is shown in Fig.1. Determine the reactive power compensation required to inject at point 'M' to reestablish original value when the voltage at 'M' falls by 6 kV (Assume 500 MVA Base and Neglect resistances)

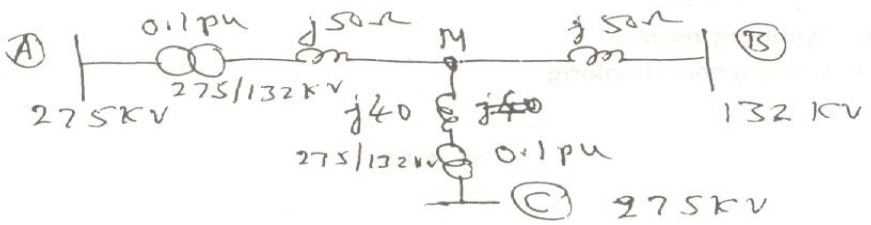

Fig.3

[14] Mention and explain in detail about generators of reactive power and absorbers of reactive power.
[15] In view of reactive power generation and absorption, briefly explain the characteristics of synchronous generator, overhead lines and cables.

MODULE-5

[1] Define system security and explain major functions involved in the system security.
[2] Explain the importance of security assessment in the power system. What are the constraints and how these constraints differ from the normal operating constraints?
[3] Distinguish between the normal operating constraints and security constraints of a power system.
[4] What are the factors which affect the power system security?
[5] What is contingency Analysis? Explain any one method of contingency evaluation
[6] What are credible contingencies? Explain the methods of analyzing such contingencies.
[7] What is Contingency Ranking?
[8] Explain the contingency analysis with the help of flow chart.
[9] Explain the role of sensitivity factors in the contingency analysis.
[10] Explain the contingency analysis using sensitivity factors with the help of flow chart
[11] What are the actions that must be taken for correcting the generation dispatch by sensitivity method?
[12] Explain the detection of network problems.

Prepared& Checked by		
12/02/2024	12.2.24	
Prof. Hemalata R Zinage	**HOD**	**Principal**

Subject Title	**ELECTRICAL ESTIMATION AND COSTING**		
Subject Code	18EE822	**CIE Marks**	40
Number of Lecture Hrs /	03	**SEE Marks**	60
Total Number of Lecture	40	**Exam Hours**	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Prof. Shivanand Hirekodi	**Designation:** Asst.Professor	**Experience:**23 yrs
No. of times course taught:03	**Specialization:** Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics engineering	IV	T&D
02	Electrical & Electronics engineering	IV	PG&E

2.0 Course Objectives

- To discuss the purpose of estimation and costing.
- To discuss market survey, estimates, purchase enquiries, tenders, comparative statement and payment of bills and Indian electricity act and some of the rules.
- To discuss distribution of energy in a building, wiring and methods of wiring, cables used in internal wiring, wiring accessories, fittings and fuses.
- To discuss design of lighting points and its number, total load, sub-circuits, size of conductor.
- To discuss different types of service mains and estimation of power circuits.
- To discuss estimation of overhead transmission and distribution system and its components.
- To discuss main components of a substation, their graphical representation and preparation of single line diagram of a substation.

3.0 Course Outcomes

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

	Course Outcome	Cognitive Level	POs
C422.1	Explain the principles of estimation and costing and IE rules.	L_1-L_2	1,2,3,6,7,8,9,10, 11,12
C422.2	Discuss wiring and methods of wiring, cables used in internal wiring, wiring accessories and fittings, fuses and types of fuses, lighting points, sub-circuits and size of conductor.	L_1-L_4	1,2,3,6,7,8,9,10, 11,12
C422.3	Discuss types of service mains and estimation of service mains and power circuits.	L_1-L_4	1,2,3,6,7,8,9,10, 11,12
C422.4	Discuss estimation of overhead transmission and distribution system and its components.	L_1-L_4	1,2,3,6,7,8,9,10, 11,12
C422.5	Discuss main components of a substation, preparation of single line diagram and estimation of a substation and earthing of a substation.	L_1-L_4	1,2,3,6,7,8,9,10, 11,12
Total Hours of instruction		**40**	

4.0 Course Content

Module-1

Principles of Estimation: Introduction to Estimation and Costing, Electrical Schedule, Catalogues, Market Survey and Source Selection, Recording of Estimates, Determination of Required Quantity of Material, Labour Conditions, Determination of Cost Material and Labour, Contingencies, Overhead Charges, Profit, Purchase System, Purchase Enquiry and Selection of Appropriate Purchase Mode, Comparative Statement, Purchase Orders, Payment Of Bills, Tender Form, General Idea about IE Rule, Indian Electricity(IE) Act and IE Rules -29,30,45,46,47,50,51,54,55,77 and79.

Module-2

Wiring: Introduction, Distribution of energy in a Building, PVC Casing and Capping, Conduit Wiring, Desirabilities of Wiring. Types of cables used in Internal Wiring, Multi Strand Cables, Voltage Grading and Specification of Cables

Wiring (continued): Main Switch and Distribution Board, Conduits and its accessories and Fittings. Lighting Accessories and Fittings, Types of Fuses, Size of Fuse, Fuse Units, Earthing Conductor.

Internal Wiring: General rules for wiring, Design of Lighting Points, Number of Points, Determination of Total Load, Number of Sub –Circuits, Ratings Main Switch and Distribution Board and Size of Conductor. Current Density, Layout.

Module-3

Service Mains: Introduction, Types, Estimation of Underground and Overhead Service Connections.

Design and Estimation of Power Circuits: Introduction, Important Considerations Regarding Motor Installation Wiring, Input Power, Input Current to Motors, Rating of Cables, Rating of Fuse, Size of Condit, Distribution Board Main Switch and Starter.

Module-4

Estimation of Overhead Transmission and Distribution Lines: Review of Line Supports, Conductor Materials, Size of Conductor for Overhead Transmission Line, Types of Insulators.

Cross Arms, Pole Brackets and Clamps, Guys and Stays, Conductors Configuration Spacing and Clearances, Span Lengths, Lightning Arrestors, Phase Plates, Danger Plates, Anti Climbing Devices, Bird Guards, Beads of Jumpers, Muffs, Points to be Considered at the Time of Erection of Overhead Lines, Erection of Supports, Setting of Stays, Fixing of Cross Arms, Fixing of Insulators, Conductor Erection, repairing and Jointing of Conductors, Dead End Clamps, Positioning of Conductors and Attachment to Insulators, Jumpers, Tee-Offs, Earthing of Transmission Lines, Guarding of Overhead Lines, Clearances of Conductor from Ground, Spacing between Conductors, Important Specifications.

Module-5

Estimation of Substations: Main Electrical connection, Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation main Connection Diagram, Single Line Diagram of Typical Substations, Equipment for Substation, Substation Auxiliaries Supply, Substation Earthing

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project work	Students can apply the knowledge of different estimation & costing methods to prepare project reports.

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Basic knowledge of estimation helps to perform internal wiring of their own house, workshops and industries and estimation of service mains.
02	Knowledge of estimation of overhead transmission, Distribution lines helps to take up contract works of KPTCL and different power Distribution Company such as HESCOM, BESCOM, and MESCOM etc.
03	Knowledge of estimation of substation helps to take up contract works of Substation installation and maintenance.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Commercial Buildings, Workshops, Industrial Installation and Substation Visits	Visits for effective learning of practical methods of Electrical Estimation & costing of different commercial Buildings, Workshops, Industry and Substation.

8.0 Books Used and Recommended to Students

Text Books
➢ Electrical Installation Estimating and Costing by J. B. Gupta Katson Books, 9th Edition, 2012

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

Website and Internet Contents References
1) libguides.library.qut.edu.au/energy/powereg 2) http://NPTEL.com 3) www.electrical4u.com

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	Electrical construction & maintenance magazine.	www.ecmweb.com/construction/estimating
2	www.ecmweb.com/construction/estimating	www.informationvine.com/Answers
3	IEEE xplore:IEEE power & Energy Magazine	ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8014

11.0 Examination Note

Scheme of evaluation for CIE (40 marks)

- Internal assessment test will be done in the same pattern as that of the main examination.
  Internal assessment: 50 marks scaled down to 30 marks
  Assignment: 10 marks

SCHEME OF EXAMINATION: 100 Marks, scaled down to 60 in VTU result sheet.

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

12.0 Course Delivery Plan

MODULE No.	Lecture No.	Content of Lecture	% of Portion
1	1.	**Principles of Estimation:** Introduction to Estimation and Costing, Electrical Schedule, Catalogues.	20%
	2.	Market Survey and Source Selection, Recording of Estimates, Determination of Required Quantity of Material.	
	3.	Labour Conditions, Determination of Cost of Material and Labour, Contingencies.	
	4.	Overhead Charges, Profit, Purchase System	
	5.	Purchase Enquiry and Selection of Appropriate Purchase Mode.	
	6.	Comparative Statement, Purchase Orders, Payment Of Bills.	
	7.	Tender Form, General Idea about IE Rule.	
	8.	Indian Electricity(IE) Act and IE Rules -29,30,45,46,47,50,51,54,55,77 and79.	
2	9.	**Wiring:** Introduction, Distribution of energy in a Building, PVC Casing and Capping, Conduit Wiring.	20%
	10.	Desirabilities of Wiring. Types of cables used in Internal Wiring.	
	11.	Multi Strand Cables, Voltage Grading and Specification of Cables.	
	12.	Main Switch and Distribution Board, Conduits and its accessories and Fittings.	
	13.	Lighting Accessories and Fittings, Types of Fuses, Size of Fuse, Fuse Units, Earthing Conductor.	
	14.	**Internal Wiring:** General rules for wiring, Design of Lighting Points.	
	15.	Number of Points, Determination of Total Load, Number of Sub –Circuits.	
	16.	Main Switch and Distribution Board and Size of Conductor. Current Density, Layout.	
	17.	Examples on design and estimation of internal wiring of different buildings.	
	18.	Examples on design and estimation of internal wiring of different buildings.	
3	19.	**Service Mains:** Introduction, Types.	
	20.	Estimation of Underground and Overhead Service Connections.	
	21.	Examples on estimation of service lines of house.	
	22.	**Design and Estimation of Power Circuits:** Introduction	

	23.	Important Considerations Regarding Motor Installation Wiring	20%
	24.	Input Power, Input Current to Motors, Rating of Cables, Rating of Fuse	
	25.	Size of Condit, Distribution Board, Main Switch and Starter	
	26.	Examples on design and estimation of Power Circuits of different installations	
4	27.	**Estimation of Overhead Transmission and Distribution Lines:** Cross Arms, Pole Brackets and Clamps, Guys and Stays, Conductors Configuration Spacing and Clearances,	20%
	28.	Span Lengths, Lightning Arrestors, Phase Plates, Danger Plates, Anti Climbing Devices, Bird Guards, Beads of Jumpers.	
	29.	Points to be Considered at the Time of Erection of Overhead Lines, Erection of Supports, Setting of Stays, Fixing of Cross Arms, Fixing of Insulators, Conductor Erection.	
	30.	Repairing and Jointing of Conductors.	
	31.	Dead End Clamps, Positioning of Conductors and Attachment to Insulators, Jumpers.	
	32.	Tee-Offs, Earthing of Transmission Lines, Guarding of Overhead Lines.	
	33.	Clearances of Conductor From Ground, Spacing Between Conductors, Important Specifications.	
	34.	Examples on design and estimation of overhead transmission lines	
5	35.	**Estimation of Substations:** Main Electrical connection	20%
	36.	Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation main connection diagram	
	37.	Single Line Diagram of Typical Substations	
	38.	Equipments for Substation	
	39.	Substation Auxiliaries Supply,	
	40.	Substation Earthing.	
	41.	Examples on estimation of indoor substations.	
	42.	Examples on estimation of outdoor substations.	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Principles of Estimation.	Students can explain basic principles of estimation.	Module 1	5	Individual Activity.	Book 1of the text book list.
2	Assignment 2: University Questions on wiring & internal wiring.	Students can design and estimate internal wiring for different buildings.	Module 2	7	Individual Activity.	Book 1of the text book list.
3	Assignment 3: University Questions on	Students can design and estimate service	Module 3	10	Individual Activity.	Book 1of the text book list.

	service mains, design & estimation of power circuits.	mains & power circuit wiring for different installations				
4	Assignment 4: University Questions on design & estimation of overhead transmission & distribution lines.	Students can design & estimate overhead transmission & distribution lines.	Module 4	12	Individual Activity.	Book 1of the text book list.
5	Assignment 5: University Questions on Estimation of substations	Students can design & estimate indoor and outdoor substations.	Module 5	16	Individual Activity.	Book 1of the text book list.

14.0 QUESTION BANK

MODULE-I

1. What is estimating?
2. List the factors to be considered for preparing estimation.
3. What is meant by electrical schedule?
4. How estimates are to be recorded?
5. Write short notes on, the following.
   i) Contingencies & Over Head Charges
   ii) Profit
   iii) Guide lines for inviting tenders
   iv) I.E. Rules
   v) I.E. Act.

MODULE-2

1. List the general rules, guidelines for residential installation.
2. Differentiate between open conduit and concealed conduit.
3. What are the different systems of wiring? Mention where which type is to be adopted.
4. What is earthing? Explain pipe earthing with a neat sketch.
5. Write the sequence to be followed for preparing estimate.
6. Differentiate between residential and commercial electrical installation.
7. What are the fundamental considerations for planning electrical installation for commercial system.
8. Write a note on bus-bar chambers.
9. Prepare an estimate of cost for a small commercial complex of 2 rooms of dimensions 4×5 sq meters with a verandah of 2.5m width in open conduit system.

MODULE-3

1. Describe the method of installation of overhead service connection.
2. Name the various lists required to be performed before connecting a new installation.
3. Describe the method of measuring insulation resistance between conductors.
4. What are the reasons for excess recording of energy consumption of energy meter?
1. Write the important consideration regarding motor installation.
2. How do determine input power and current for a motor?
3. How the main switch and starters are determined?
4. A 15 HP motor is to be installed with star-delta starter at a distance of 15m from the available 3-phase 400V mains in the same hall. Prepare an estimate of cost for the above wiring.
5. The following machines have to be commissioned in a workshop of inner dimensions 10m×8m
   i) 4 lathes of 2HP each.
   ii) 1 milling machine of 10HP.
   iii) 1 drilling machine of 1HP. All operating on 440V supply.

   It is to be wired for both power and lighting circuits.
   a) Estimate the no. and rating of lighting outlets.
   b) Propose the type of wiring for both lighting and power circuits and justify them.
   c) Prepare the estimate of cost under the following heads.

MODULE-4

1. What are the factors governing height of a pole?
2. How the conductor size is determined in O.H transmission line?
3. Write a note on,
   i. Position of conductors and attachment to insulator.
   ii. Erection of conductor.
   iii. Erection of supports.
   iv. Guarding of O.H line.
4. Write the specification of following
   i. G.O.S
   ii. Lightening arrestor
   iii. Pin insulator for 11kV line
5. Estimate the material for 11kV line for a distance of 2km. The line crosses a railway line and a highway.

MODULE-5:

1. Give the classification of substations.
2. What are the advantages and disadvantages of outdoors stations over indoor substation?
3. Give key diagram of typical 33kV substation.
4. Give main connection for auxiliary supply in 110/11kV substation.
5. What are the factors to be considered for the site selection for substation?
6. Writea short note on, i) Pole mounted substation. Ii) Indoor substation. Iii) Equipment for indoor substation.

Prepared by	Checked by		
07/02/24	7/2/24	7/2/24	
Prof.Shivanand Hirekodi	**Prof.O.B.Heddurshetti.**	**HOD**	**Principal**