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 by 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

To educate students with core knowledge of electrical and electronics engineering by developing problem solving skills, professional skills, social awareness to excel in their career.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's) :

1. Posses successful careers in Electrical Sciences & apply the knowledge of mathematics & Engineering fundamentals to analyze & formulate the solution to solve real time problems.
2. Excel in academics, industry, entrepreneurship, administrative services through lifelong learning.
3. Exhibit professional & ethical values, effective communication skills, teamwork skills, multidisciplinary approach & an ability to realize engineering issues to broader social context.

PROGRAM OUTCOMES (PO's) :

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 modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in

multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO's) :

1. An ability to demonstrate knowledge & competencies to analyze & design electrical & electronics circuits, control and power systems, machines & industrial drives.
2. An ability to use software tools for the design, simulation and analysis of electrical and electronics systems.

Contents of IV-SEM

1.0 Student Help Desk

SL. No	Puarticulars	Contact Person	
		Faculty	Instructor
1	Attestations	Dr. B. V.Madiggond	--
2	Exam forms signature, Overall department administration, Counseling/interaction with parents.		--
3	Research Centre Coordinator	Dr. B. V.Madiggond	--
4	Academic Coordinator	Prof. S.D.Hirekodi	--
5	Online submission of exam form/revaluation form to VTU,IA coordinator, Wall Magazine	Prof. S S Birade	Shri.V.N.Kamate Shri.S.B.Beelur
6	Department Association Coordinator	Prof. S. B. Patil, Prof.A.U.Neshti	--
7	Dept NBA Coordinator	Prof.M.P.Yanagimath	--
8	AICTE/VTU,NIRF	Prof. K. B Negalur	Sri. R. S. Bardol
9	Dept.TP Cell Coordinator	Prof. O. B. Heddurashetti	Sri. V. N. Kamate
10	Dept Alumni, Internship, III Cell Coordinator	Prof. P M Murari	--

11	Dept Robovidya, IEEE,ISTE coordinator	Prof. S.G.Huddar	Sri. V.M.Mutalik, Shri.R.S.Bardol, Shri.V.N.Kamate
12	Department Library Coordinator	Prof. Amit U Nesthi	Sri.S.B.Beelur
13	Department News Letter Coordinator	Prof. S.B.Patil	Sri.V.M.Mutalik
14	Project Coordinator	Prof. M.P.Yanagimath	--
15	Seminar Coordinator	Prof. M.P.Yanagimath	--
16	Dept meeting Coordinator	Prof.H.R.Zinage	--

SL. No	Puarticulars		
17	Electrical Maintenance	Prof.S.D.Hirekodi	
18	Warden HIT Ladies Hostel	Prof.H.R.Zinage	
19	Chief Alumini Coordinator	Prof.O.B.Heddurshetti	
20	Extra Curricular/Sports/Cultural Institute industry Engineering Coordinator	Prof.A.U.Neshti	
21	SC/ST cell Convener, Entrepreneurship cell Coordinator, Discipline cell Coordinator	Prof. K. B. Negalur	
22	IEEE, News/Publicity committee member	Prof.S.G.Huddar	
23	Dept. Web coordinator	Prof. V.B.Dhere	
24	Dispensary	Dr. Arun G. Bullannavar Contact No. 9449141549	

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	13	16
2	Technical supporting staff	4	20
3	Helper	2	15

2.2 Major Laboratories

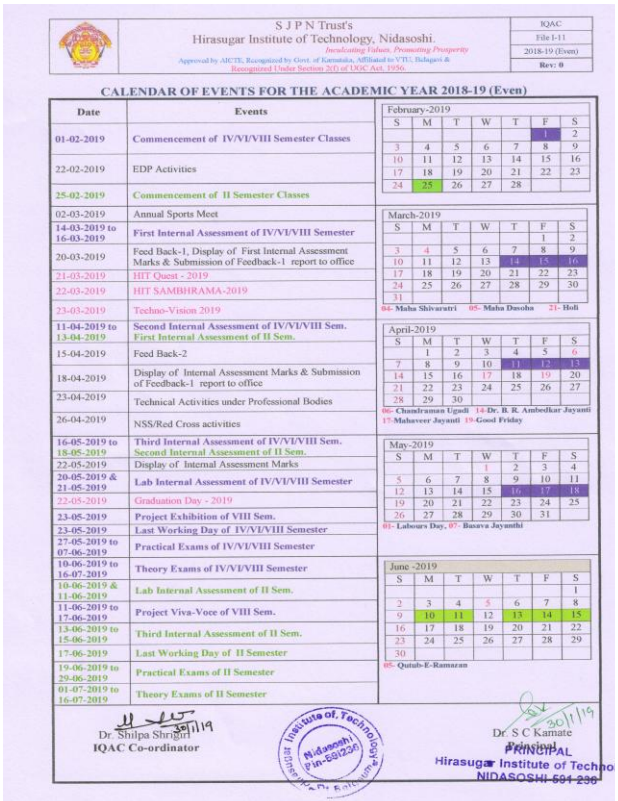
SN	Name of the Laboratory	Carpet Area (Sq.mt)	Total investment till date
1.	Electronics Lab	92	576516.80
2.	Operational Amplifiers & Linear IC Lab	72	111537.00
3.	Power Electronics Lab	92	770111.00
4. Microcontroller Lab 5. DSP Lab		72	582174.00
6.	Control System Lab	72	212755.00
7.	Electrical Machines Lab	200	807672.00
8.	Relay & HV Lab	138	603254.00
10.	Computer Aided Electrical Drawing Lab	71	650988.43
Grand Total :		**5441609.00**	

3.0 Teaching Faculty Details

Sr. No.	Faculty Name	Designation	Qualification	Area of specialization	Professional membership	Industry Experience (in years)	Teaching Experience (in years)	Contact Nos.
1.	Dr.B.V.Madiggond	HOD/Prof	Ph.D	Power Electronic	LMISTE,YHAI	-	25	9343454993
2	Prof. S. B. Patil	Asst. Prof.	M. Tech	Power & Energy System	LMISTE	-	33	8050234360
3	Prof.V.B.Dhere	Asst.Prof	M.Tech, (Ph.D)	Electronics & Telicommunication	LMISTE, IMPARC	**4**	21	9886597573
4	Prof. S. D. Hirekodi	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	18	9480849338

5	Prof. H. R. Zinage	Asst. Prof.	M. Tech	Power System	LMISTE	-	18	9480849335
6	Prof. M. P. Yanagimath	Asst. Prof.	M.Tech (Ph.D)	VLSI & ES	LMISTE	1	13	9341449466
7	Prof. O. B. Heddurshetti	Asst. Prof.	M. Tech.	Power Electrics	LMISTE	1	11	9448120509
8	Prof. A. U. Neshti	Asst. Prof.	M. Tech.	Digital Electronics	LMISTE	-	10	9538223362
9	Prof. P. M. Murari	Asst. Prof.	M. Tech.	PS & PE	LMISTE	-	07	9739733001
10	Prof. S. S. Birade	Asst. Prof.	M. Tech.	VLSI Design & ES	LMISTE	-	06	9945105480
11	Prof. K. B. Negalur	Asst. Prof.	M. Tech.	Industrial Electronics	LMISTE	-	05	9886644507
12	Prof. S. G. Huddar	Asst. Prof.	M. Tech.	Power System	LMISTE	-	05	9742066852

4.0 Institute Academic calendar



S J P N Trust's
Hirasugar Institute of Technology, Nidasoshi.
Inculcating Values, Promoting Prosperity
Approved by AICTE, Recognized by Govt. of Karnataka, Affiliated to VTU, Belagavi & Recognized Under Section 2(f) of UGC Act, 1956.

IQAC
File I-11
2018-19 (Even)
Rev: 0

CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2018-19 (Even)

Date	Events
01-02-2019	Commencement of IV/VI/VIII Semester Classes
22-02-2019	EDP Activities
25-02-2019	Commencement of II Semester Classes
02-03-2019	Annual Sports Meet
14-03-2019 to 16-03-2019	First Internal Assessment of IV/VI/VIII Semester
20-03-2019	Feed Back-1, Display of First Internal Assessment Marks & Submission of Feedback-1 report to office
21-03-2019	HIT Quest - 2019
22-03-2019	HIT SAMBHRAMA-2019
23-03-2019	Techno-Vision 2019
11-04-2019 to 13-04-2019	Second Internal Assessment of IV/VI/VIII Sem. First Internal Assessment of II Sem.
15-04-2019	Feed Back-2
18-04-2019	Display of Internal Assessment Marks & Submission of Feedback-1 report to office
23-04-2019	Technical Activities under Professional Bodies
26-04-2019	NSS/Red Cross activities
16-05-2019 to 18-05-2019	Third Internal Assessment of IV/VI/VIII Sem. Second Internal Assessment of II Sem.
22-05-2019	Display of Internal Assessment Marks
20-05-2019 & 21-05-2019	Lab Internal Assessment of IV/VI/VIII Semester
22-05-2019	Graduation Day - 2019
23-05-2019	Project Exhibition of VIII Sem.
23-05-2019	Last Working Day of IV/VI/VIII Semester
27-05-2019 to 07-06-2019	Practical Exams of IV/VI/VIII Semester
10-06-2019 to 16-07-2019	Theory Exams of IV/VI/VIII Semester
10-06-2019 & 11-06-2019	Lab Internal Assessment of II Sem.
11-06-2019 to 17-06-2019	Project Viva-Voce of VIII Sem.
13-06-2019 to 15-06-2019	Third Internal Assessment of II Sem.
17-06-2019	Last Working Day of II Semester
19-06-2019 to 29-06-2019	Practical Exams of II Semester
01-07-2019 to 16-07-2019	Theory Exams of II Semester

February-2019

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
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17	18	19	20	21	22	23
24	25	26	27	28		

March-2019

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17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

04- Maha Shivaratri 05- Maha Dasoha 21- Holi

April-2019

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	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				

06- Chandraman Ugadi 14-Dr. B. R. Ambedkar Jayanti
17-Mahaveer Jayanti 19-Good Friday

May-2019

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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

01- Labours Day, 07- Basava Jayanthi

June -2019

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16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

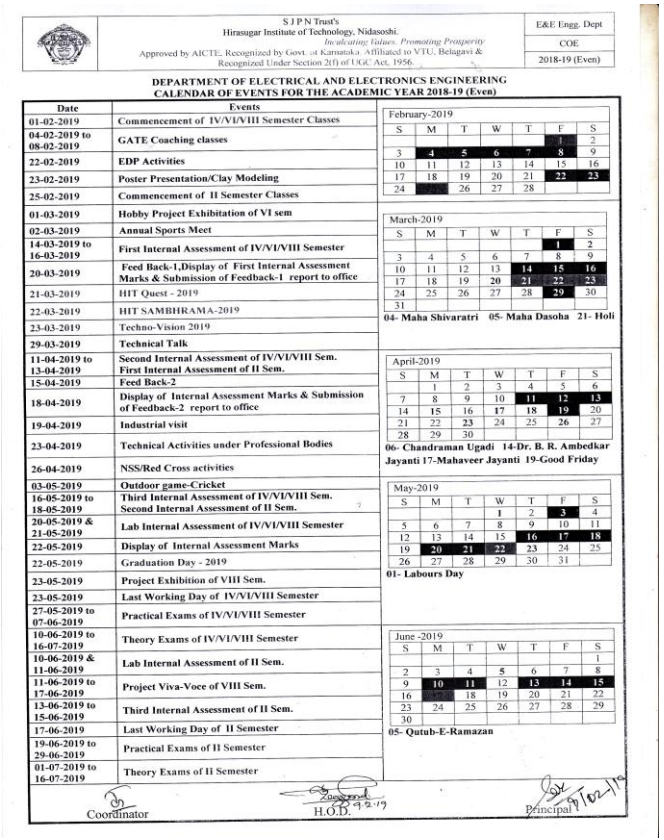
05- Qutub-E-Ramazan

30/1/19
Dr. Shilpa Shrigiri
IQAC Co-ordinator

Hirasugar Institute of Technology Nidasoshi Pin-591236

30/1/19
Dr. S C Kamate
Principal
PRINCIPAL
Hirasugar Institute of Techno
NIDASOSHI 591 236

5.0 Department Academic calendar



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E&E Engg. Dept | COE | 2018-19 (Even)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2018-19 (Even)

Date	Events
01-02-2019	Commencement of IV/VI/VIII Semester Classes
04-02-2019 to 08-02-2019	GATE Coaching classes
22-02-2019	EDP Activities
23-02-2019	Poster Presentation/Clay Modeling
25-02-2019	Commencement of II Semester Classes
01-03-2019	Hobby Project Exhibitation of VI sem
02-03-2019	Annual Sports Meet
14-03-2019 to 16-03-2019	First Internal Assessment of IV/VI/VIII Semester
20-03-2019	Feed Back-1,Display of First Internal Assessment Marks & Submission of Feedback-1 report to office
21-03-2019	HIT Quest - 2019
22-03-2019	HIT SAMBHRAMA-2019
23-03-2019	Techno-Vision 2019
29-03-2019	Technical Talk
11-04-2019 to 13-04-2019	Second Internal Assessment of IV/VI/VIII Sem. First Internal Assessment of II Sem.
15-04-2019	Feed Back-2
18-04-2019	Display of Internal Assessment Marks & Submission of Feedback-2 report to office
19-04-2019	Industrial visit
23-04-2019	Technical Activities under Professional Bodies
26-04-2019	NSS/Red Cross activities
03-05-2019	Outdoor game-Cricket
16-05-2019 to 18-05-2019	Third Internal Assessment of IV/VI/VIII Sem. Second Internal Assessment of II Sem.
20-05-2019 & 21-05-2019	Lab Internal Assessment of IV/VI/VIII Semester
22-05-2019	Display of Internal Assessment Marks
22-05-2019	Graduation Day - 2019
23-05-2019	Project Exhibition of VIII Sem.
23-05-2019	Last Working Day of IV/VI/VIII Semester
27-05-2019 to 07-06-2019	Practical Exams of IV/VI/VIII Semester
10-06-2019 to 16-07-2019	Theory Exams of IV/VI/VIII Semester
10-06-2019 & 11-06-2019	Lab Internal Assessment of II Sem.
11-06-2019 to 17-06-2019	Project Viva-Voce of VIII Sem.
13-06-2019 to 15-06-2019	Third Internal Assessment of II Sem.
17-06-2019	Last Working Day of II Semester
19-06-2019 to 29-06-2019	Practical Exams of II Semester
01-07-2019 to 16-07-2019	Theory Exams of II Semester

February-2019

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

March-2019

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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

04- Maha Shivaratri 05- Maha Dasoha 21- Holi

April-2019

S	M	T	W	T	F	S
	1	2	3	4	5	6
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14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

06- Chandraman Ugadi 14-Dr. B. R. Ambedkar Jayanti 17-Mahaveer Jayanti 19-Good Friday

May-2019

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

01- Labours Day

June -2019

S	M	T	W	T	F	S
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16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

05- Qutub-E-Ramazan

Coordinator H.O.D. 29.2.19 Principal 01/02/19

5.1 Scheme of Teaching & Examination

VIII SEMESTER

Sl. No	Course Code	Subject (Course)	Title	Teaching Department	Teaching Hours /Week		Examination				Credits
					Theory	Practical/ Drawing	Duration in hours	I.A. Marks	Theory/ Practical Marks	Total Marks	
1	15EE81	Core Subject	Power System Operation and Control	EEE	04	–	03	20	80	100	4
2	15EE82	Core Subject	Industrial Drives and Applications	EEE	04	–	03	20	80	100	4
3	15EE83X	Professional Elective	Professional Elective – V	EEE	03	–	03	20	80	100	3
4	15EE84	Core Subject	Internship / Professional Practice	EEE	Industry Oriented		03	50	50	100	2
5	15EEP85	Core Subject	Project Work Phase -II	EEE	–	06	03	100	100	200	6
6	15EES86	Core Subject	Seminar	EEE	–	04	–	100	–	100	1
				TOTAL	**Theory:11 hours Practical: 10 hours**		**15**	**310**	**390**	**700**	**20**

Professional Elective – V

Courses under Code 15EE83X	Title
15EE831	Smart Grid
15EE832	Operation and Maintenance of Solar Electric Systems
15EE833	Integration of Distributed Generation
15EE834	Power System in Emergencies

1. **Core subject:** This is the course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.
2. **Professional Elective:** Elective relevant to chosen specialization/ branch.
3. **Internship / Professional Practice:** To be carried between the VI and VIIsemester vacation or VII and VIII semester vacation period.

Subject Title	POWER SYSTEM OPERATION &CONTROL		
Subject Code	15EE81	**IA Marks**	20
Number of Lecture Hrs / Week	04 L	**Exam Marks**	80
Total Number of Lecture Hrs	50	**Exam Hours**	03

FACULTY DETAILS:		
Name: Prof.Hemalata R Zinage	**Designation:** Asst.Professor	**Experience:**18
No. of times course taught:06	**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

To describe various levels of controls in power systems and the vulnerability of the system.

- To explain components, architecture and configuration of SCADA.
- To define unit commitment and explain various constraints in unit commitment and the solution methods
- To explain issues of hydrothermal scheduling and solutions to hydro thermal problems
- To explain basic generator control loops, functions of Automatic generation control, speed governors and mathematical models of Automatic Load Frequency Control
- To explain automatic generation control, voltage and reactive power control in an interconnected power system.
- 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 draw and use modeling software's to generate

	Course Outcome	Cognitive Level	POs
CO1	Describe various levels of controls in power systems, the vulnerability of the system, components, architecture and configuration of SCADA and solve unit commitment problems	L3	1,2,4,5,10,12
CO2	Explain issues of hydrothermal scheduling and solutions to hydro thermal problems	L3,l4	1,2,4,5,10,12
CO3	Explain basic generator control loops, and develop & analyze mathematical models of Automatic Load Frequency Control	L3,L4	1,2,4,5,10,12
CO4	Explain automatic generation control, voltage and reactive power control in an interconnected power	L3,L4	1,2,4,5,10,12
CO5	Explain reliability, security, contingency analysis, state estimation and related issues of power systems.		1,2,4,5,10,12
Total Hours of instruction		**50**	

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 Centres.

Supervisory Control and Data acquisition (SCADA): Introduction to SCADA and its Components, Standard SCADA Configurations, Users of Power Systems SCADA, Remote Terminal Unit for Power System SCADA, Common Communication Channels for SCADA in Power Systems, Challenges for Implementation of SCADA.
Unit Commitment: Introduction, Simple Enumeration Constraints, Priority List Method, Dynamic Programming Method for Unit Commitment.

10hrs

Revised Bloom's Taxonomy Level
L_1 – Remembering, L_2 – Understanding, L_4 – Analysing.

Module-2
Hydro-thermal Scheduling: Introduction, Scheduling Hydro Systems, Discrete Time Interval Method, Short Term Hydro Thermal Scheduling Using $\gamma - \lambda$ Iterations, Short Term HydroThermal Scheduling Using Penalty Factors.
Automatic Generation Control (AGC): Introductions, Basic Generator Control Loops, Commonly used Terms in AGC, Functions of AGC, Speed Governors.

10hrs

Revised Bloom's Taxonomy Level
L_2 – Understanding, L_3 – Applying, L_4 – Analysing.

Module-3
Automatic Generation Control (continued): Mathematical Model of Automatic Load Frequency Control, AGC Controller, Proportional Integral Controller.
Automatic Generation Control in interconnected Power system: Introductions, Tie – Line Control with Primary Speed Control, Frequency Bias Tie - Line Control, State-Space Models.

10hrs

Revised Bloom's Taxonomy Level
L_3 – Applying.

Module-4
Automatic Generation Control in interconnected Power system (continued): State-Space Model for Two - Area System, Tie-Line Oscillations, Related Issues in Implementation of AGC.
Voltage and Reactive Power Control: Introduction, Production and Absorption of Reactive Power, Methods of Voltage Control, Dependence of Voltage on Reactive Power , Sensitivity of Voltage to Changes in P And Q, Cost Saving, Methods of Voltage Control by Reactive Power Injection, Voltage Control Using Transformers, Voltage Stability.

10hrs

Revised Bloom's Taxonomy Level
L_3 – Applying.

Module-5
Power System Reliability and Security: Introduction, Security Levels of System, Reliability Cost, Adequacy Indices, Functions of System Security, Contingency Analysis, Linear Sensitivity Factors, Contingency Selection and Ranking.
State estimation of Power Systems: Introduction, Linear Least Square Estimation, DC State Estimator, Other Issues in State Estimation.

10hrs

Revised Bloom's Taxonomy Level
L_2 – Understanding, L_3 – Applying, L_4 – Analysing.

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.Power System Operation and Control K. Uma Rao Wiley 1st Edition, 2012
Reference Books
1.Power Generation Operation and Control Allen J Wood etal Wiley 2nd Edition,2003 2. Power system stability and control, Prabha Kundur, TMH, 9th reprint, 2007.
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	***Journal* of Modern *Power Systems* and Clean Energy**	***www.springer.com***

11.0 Examination Note

Internal Assessment: 20 Marks

Three internal assessment tests will be conducted. Out of the three tests, average marks of the best two tests marks will be considered. The students will write the internal assessment tests in separate IA test books.

Scheme of Evaluation for Internal Assessment (25 Marks)

Two questions to be set for 12.5 mark each. Student has to answer for both the questions. There will be two sub-questions of 6 and 6.5 marks for each main question. However, there will be an alternate optional question for each sub-question.

Unit No.	Lecture No.	Content of Lecture	% of Portion
I	1.	**Introduction:** Operating States of Power System,	20
	2.	Objectives of Control, Key Concepts of Reliable Operation	
	3.	Preventive and Emergency Controls, Energy Management Centers	
	4.	**Supervisory Control and Data acquisition (SCADA):** Introduction to SCADA and its Components,	
	5.	Standard SCADA Configurations, Users of Power Systems SCADA,	
	6.	Remote Terminal Unit for Power System SCADA, Common Communication Channels for SCADA in Power Systems,	
	7.	Challenges for Implementation of SCADA	
	8.	**Unit Commitment:** Introduction, Simple Enumeration Constraints,	

	9.	Priority List Method	
	10.	Dynamic Programming Method for Unit Commitment.	
II	11.	**Hydro-thermal Scheduling:** Introduction, Scheduling Hydro Systems,	
	12.	Discrete Time Interval Method,	
	13.	Short Term HydroThermal Scheduling Using $\gamma - \lambda$ Iterations,	
	14.	Short Term Hydro Thermal Scheduling Using $\gamma - \lambda$ Iterations,	
	15.	Short Term HydroThermal Scheduling Using Penalty Factors.	**20**
	16.	**Automatic Generation Control (AGC):** Introductions,	
	17.	Basic Generator Control Loops	
	18.	Commonly used Terms in AGC,	
	19.	Functions of AGC,	
	20.	Speed Governors	
III	21.	**Automatic Generation Control (continued):** Mathematical Model of Automatic Load Frequency Control,	
	22.	Mathematical Model of Automatic Load Frequency Control,	
	23.	Mathematical Model of AGC Controller	
	24.	Mathematical Model of Proportional Integral Controller.	
	25.	**Automatic Generation Control in interconnected Power system:** Introductions	
	26.	Tie – Line Control with Primary Speed Control	**20**
	27.	Frequency Bias Tie - Line Control	
	28.	Frequency Bias Tie - Line Control	
	29.	State-Space Models.	
	30.	**Automatic Generation Control in interconnected Power system (continued):** State-Space Model for Two - Area System,	
IV	31.	State-Space Model for Two - Area System,	
	32.	Tie-Line Oscillations	
	33.	Related Issues in Implementation of AGC.	
	34.	**Voltage and Reactive Power Control:** Introduction	
	35.	Production and Absorption of Reactive Power	
	36.	Methods of Voltage Control	**20**
	37.	Dependence of Voltage on Reactive Power	
	38.	Sensitivity of Voltage to Changes in P And Q, Cost Saving	
	39.	Methods of Voltage Control by Reactive Power Injection	
	40.	Voltage Control Using Transformers, Voltage Stability.	
V	41.	**Power System Reliability and Security:** Introduction, Security Levels of System, Reliability	
	42.	Cost, Adequacy Indices	
	43.	Functions of System Security	
	44.	Contingency Analysis	
	45.	Linear Sensitivity Factors	
	46.	Contingency Selection and Ranking	**20**
	47.	**State estimation of Power Systems:** Introduction	
	48.	Linear Least Square Estimation	
	49.	DC State Estimator	
	50.	Other Issues in State Estimation.	

12.0 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 2 of the Text book list. Website of the Reference list
3	Assignment3: University Questions onAutomatic 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 2 of the Text book list. Website of the Reference list
4	Assignment 4: university Questions Voltage and Reactive Power Control	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity.	Book 4 of the Text book list. Website of the Reference list
5	Power System Reliability and Security & State estimation of Power Systems	Students study the Topics and write the Answers. Get practice to solve university questions.	module 5 of the syllabus	10	Individual Activity.	Book 3 of the Text book list. Website of the Reference list

13.0 QUESTION BANK

MODULE -1

[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.

Unit commitment

[1] Discuss the problem of unit commitment.
[2] Define unit commitment problem as applied to power system. State the factors to be considered for unit commitment
[3] Define the problem of unit commitment and briefly describe the constraints to be considered in a thermal system for unit commitment.
[4] Explain the thermal unit constraints placed in the unit commitment problem.
[5] State and explain the problem of unit commitment. What are the constraints in solving the unit commitment problem?
[6] What is unit commitment problem? Discuss the constraints and role of spinning reserves in unit commitment problem.
[7] Explain the simple shut down rule followed in priority list method for unit commitment.
[8] Explain any two methods of solving unit commitment problem.
[9] With the help of flow chart, explain the dynamic programming method of unit commitment.
[10]Difference between the load scheduling and unit commitment.

MODULE-2

[1] Explain the discrete time interval method of hydro system scheduling.
[2] Describe short term hydro thermal scheduling using γ-λ iterations.
[3] What is short term hydro thermal scheduling using penalty factor?
[4] Why automatic generation & voltage control is required? Explain.

[5] Explain the objectives and functions of Automatic Generation Control (AGC) in a Power System
[6] Explain the complete block diagram representation of load frequency control of an isolated power system.
[7] Explain how mathematical model of speed governing system is developed for automatic generation control

MODULE-3 Automatic Generation control

[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 08M

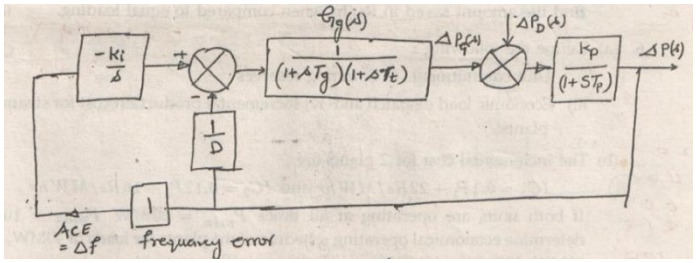


Fig.2

MODULE-4

[1] Obtain the block diagram for a Tie-line bias control of a two area load frequency control and explain the functioning of a block diagram.

[2] Considering the two-area system shown in Fig.1, Find the new steady state frequency and change in tie-line flow for a load change of area 2 by 100MW.Assume Following data for the system;

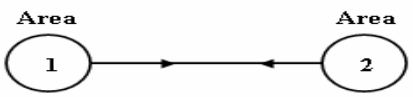
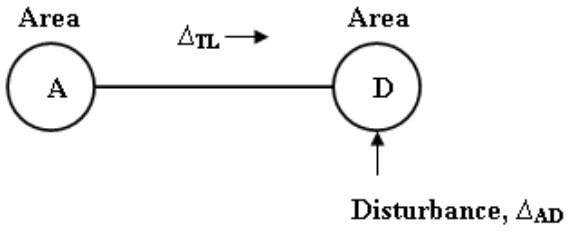


Fig-3

Capacity of area 1,P_{r1} =1000MW,
Capacity of area 2,P_{r2} =2000MW,
Nominal load of area 1, P^0_{D1} = 500MW
Nominal load of area 2, P^0_{D2} = 1500MW
Regulation of area 1, R_1=5%
Regulation of area 2, R_2=4%
Nominal frequency, f^0 =50Hz

For both the areas, each percent change in frequency causes 1% change in the load. Find also the amount Of additional frequency drop if the interconnection is lost due to certain reasons.

[3] Two areas A & D are interconnected. shown in Fig.1. The generating capacity of area A is 36000MW and its regulating characteristic is 1.5% of capacity per 0.1 Hz. Area D has a generating capacity of 4000 MW and its regulating characteristic is 1% of capacity per 0.1 Hz. Find each area's share of a +400 MW load increase occurring in area D and resulting tie-line flow.



[4] What is voltage stability problem in power system? Explain with suitable figure and illustrations, how does it depend upon temperature and power factor?

[5] Clearly distinguish between the angle stability and voltage stability of a power system

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

[7] What is voltage instability? Explain the phenomenon of voltage collapse with relevant PV and QV diagrams.

[8] What is voltage collapse? Explain with PV and QV characteristics of loads

[9] Explain how the voltage control is achieved by injection of reactive power at nodes

[10] 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

[11]. Explain different methods of voltage control.

[12] Describe the control characteristics of an SVC.

[13 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

[14] 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)

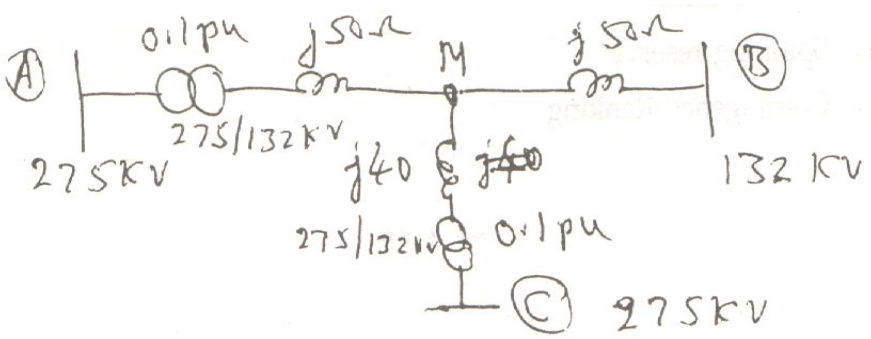


Fig.4

[15] Mention and explain in detail about generators of reactive power and absorbers of reactive power.
[16] In view of reactive power generation and absorption, briefly explain the characteristics of synchronous generator, overhead lines and cables.
[17] What is series compensation? Explain the advantages of series compensation.
[18] Discuss about subsynchronous resonance.
[19] Describe the SSR in series compensated systems
[20] The load at the receiving end of a 3φ overhead line is 25 Mw, power factor 0.8 lagging, at a line voltage of 33kV. A synchronous compensator is situated at the receiving end and the voltage at both ends of the line is maintained at 33kV. Calculate (making use of $\partial Q/\partial V$ at the receiving end) the MVAR of the compensator. The line has resistance of 5Ω/phase and inductive reactance (line to neutral) 20 Ω/phase.
[21] A 132kV line is fed through a 11/132kV transformer from a constant 11kV supply. At the load end of the line the voltage is reduced by another transformers of nominal ratio 132/11kV. The total impedance of the line and transformer at 132kv is (25+j66) Ω. Both transformers are equipped with tap changing facilities which are so arranged that the product of the two off nominal settings is unity. If the load on the system is 100Mw at 0.9 pf lagging, calculate setting of tap changers required to maintain the voltage of the load bus bar at 11kV. Use a base of 100MVA.
[22] A 220 kV line has tap changing transformers at both ends. The transformer at the sending end has a nominal ratio 11/132 kV and that at the receiving end is 132/11kV. The line impedance is (10 + j50) Ω. and the load at the receiving end is 150Mw at 0.8 pf lagging. Assuming $t_s t_r=1$,find the tap setting to give 11kVto load bus.

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]What is energy management system?
[13]Describe the process of power system state estimation mathematically.
[14]Explain the least square estimation technique.
[15]Explain the minimization techniques for PSSE.
[16]Explain the modes of failures of a system.
[17]Explain the generating system and its performance.
[18] Derive the expression of reliability index.
[19]Discuss reliability measure for N- unit system.
[20]What are cumulative probability outages- Recursive Relation?
[21]What is loss of load probability?

15.0 University Result

Examination	FCD	FC	SC	% Passing
July-2017	17	24	20	100
July-2018	08	18	29	96.49

Prepared by	Checked by		
		31.1.19	
Prof.Hemalata R Zinage	Prof.S B Patil	HOD	Principal

Subject Title	**INDUSTRIAL DRIVES AND APPLICATIONS**		
Subject Code	15EE82	**IA Marks**	20
Number of Lecture Hrs / Week	04	**Exam Marks**	80
Total Number of Lecture Hrs	50	**Exam Hours**	03
			CREDITS – 04

FACULTY DETAILS:		
Name: Mr. Sagar S Birade	**Designation:** Asst. Professor	**Experience:** 07 Years
No. of times course taught: 01	**Specialization:** VLSI Design & Embedded Systems	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical &Electronics Engineering	IV	Electric Motors
02	Electrical &Electronics Engineering	V	Power Electronics

2.0 Course Objectives

1. To define electric drive, its parts, advantages and explain choice of electric drive.
2. To explain dynamics and modes of operation of electric drives.
3. To explain selection of motor power ratings and control of dc motor using rectifiers.
4. To analyze the performance of induction motor drives under different conditions.
5. To explain the control of induction motor, synchronous motor and stepper motor drives.
6. To discuss typical applications electrical drives in the industry.

3.0 Course Outcomes

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

	Course Outcome	RBT Level	POs
CO 1	Discuss the advantages and choice of electric drive and Explain dynamics and different modes of operation of electric drives.	L1, L2, L3, L4	1,2,3,5,8
CO 2	Suggest a motor for a drive and control of dc motor using controlled rectifiers.	L1, L2, L3, L4	1,2,3,5,8
CO 3	Analyze the performance of induction motor drives under different conditions.	L2, L3, L4, L5	1,2,3,5,8
CO 4	Control induction motor, synchronous motor and stepper motor drives.	L1, L2, L3, L4	1,2,3,5,8
CO 5	Suggest a suitable electrical drive for specific application in the industry.	L1, L2, L3, L4	1,2,3,5,8
	Total Hours of instruction	**50**	

4.0 Course Content

Module-1

Electrical Drives: Electrical Drives, Advantages of Electrical Drives. Parts of Electrical Drives, Choice of Electrical Drives, Status of dc and ac Drives.

Dynamics of Electrical Drives: Fundamental Torque Equations, Speed Torque Conventions and Multi quadrant Operation. Equivalent Values of Drive Parameters, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time and Energy Loss in Transient Operations, Steady State Stability, Load Equalization.

Control Electrical Drives: Modes of Operation, Speed Control and Drive Classifications, Closed loop Control of Drives.

10 Hours

Module-2

Selection of Motor Power Ratings: Thermal Model of Motor for Heating and Cooling, Classes of Motor Duty, Determination of Motor Rating.
Direct Current Motor Drives: Controlled Rectifier Fed dc Drives, Single Phase Fully Controlled Rectifier Control of dc Separately Excited Motor, Single Phase Half Controlled Rectifier Control of dc Separately Excited Motor, Three Phase Fully Controlled Rectifier Control of dc Separately Excited Motor, Three Phase Half Controlled Rectifier Control of dc Separately Excited Motor, Multi quadrant Operation of dc Separately Excited Motor Fed Form Fully Controlled Rectifier, Rectifier Control of dc Series Motor, Supply Harmonics, Power Factor and Ripple in Motor Current, Chopper Control of Separately Excited dc Motor, Chopper Control of Series Motor.

10 Hours

Module-3

Induction Motor Drives: Analysis and Performance of Three Phase Induction Motors, Operation with Unbalanced Source Voltage and Single Phasing, Operation with Unbalanced Rotor Impedances, Analysis of Induction Motor Fed From Non-Sinusoidal Voltage Supply, Starting, Braking, Transient Analysis. Speed Control Techniques-Stator Voltage Control, Variable Voltage Frequency Control from Voltage Sources.

10 Hours

Module-4

Induction Motor Drives (continued): Voltage Source Inverter (VSI) Control, Cyclo converter Control, Closed Loop Speed Control and Converter Rating for VSI and Cyclo converter Induction Motor Drives, Variable Frequency Control from a Current Source, Current Source (CSI) Control, current regulated voltage source inverter control, speed control of single phase induction motors.
Synchronous Motor Drives: Operation from fixed frequency supply-starting, synchronous motor.

10 Hours

Module-5

Synchronous Motor Drives (continued): Self-controlled synchronous motor drive employing load commutated thyrister inverter, Starting Large Synchronous Machines, Permanent Magnet ac (PMAC) Motor Drives, Sinusoidal PMAC Motor Drives, Brushless dc Motor Drives.
Stepper Motor Drives: Variable Reluctance, Permanent Magnet, Important Features of Stepper Motors, Torque Versus Stepping rate Characteristics, Drive Circuits for Stepper Motor.
Industrial Drives: Textile Mills, Steel Rolling Mills, Cranes and Hoists, Machine Tools.

10 Hours

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01			

6.0 Relevance to Real World

Sl No	Real World Mapping
01	Study of various components of drives.
02	Conduct investigations of complex problems of controlling industrial drives

7.0 Gap Analysis and Mitigation

Sl No	Delivery Type	Details
01	Tutorial	Textile Mills, Steel Rolling Mills, Cranes and Hoists, Machine Tools
02	NPTEL	Control Electrical Drives

8.0 Books Used and Recommended to Students

Text Books
1. 'Fundamentals of Electrical Drives', by Gopal K. Dubey, Narosa Publishing House 2nd Edition, 2001.
2. 'Electrical Drives: Concepts and Applications' by Vedum Subrahmanyam McGraw Hill 2nd Edition, 2011.

Reference Books
1. 'Electric Drives' by N.K De, P.K. Sen, PHI Learning 1st Edition, 2009

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

Website and Internet Contents References
https://nptel.ac.in/courses/108108077/
www.srmuniv.ac.in/sites/.../EI03INDUSTRIALDRIVESCONTROL_EIE6thsem.pdf

10.0 Magazines/Journals Used and Recommended to Students

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

11.0 Examination Note

Internal Assessment: 20 Marks
There are four main questions of 10 Marks
Students have to answer any two full questions of each 10 Marks selecting from Q. No 1 & Q. No 2.

Scheme of Evaluation for Internal Assessment (20 Marks)
Internal Assessment tests (3 IA's) will be done in the same pattern as that of the main examination. Best of the two tests average marks are finalized as internal marks.

SCHEME OF EXAMINATION:

The question paper will have ten questions.

- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
1	1	**Electrical Drives:** Electrical Drives, Advantages of Electrical Drives.	20
	2	Parts of Electrical Drives, Choice of Electrical Drives, Status of dc and ac Drives.	
	3	**Dynamics of Electrical Drives:** Fundamental Torque Equations.	
	4	Speed Torque Conventions and Multi quadrant Operation.	
	5	Equivalent Values of Drive Parameters, Components of Load Torques.	
	6	Nature and Classification of Load Torques.	
	7	Calculation of Time and Energy Loss in Transient Operations.	
	8	Steady State Stability, Load Equalization.	
	9	**Control Electrical Drives:** Modes of Operation.	
	10	Speed Control and Drive Classifications, Closed loop Control of Drives.	
2	11	**Selection of Motor Power Ratings:** Thermal Model of Motor for Heating and Cooling.	20
	12	Classes of Motor Duty, Determination of Motor Rating.	
	13	**Direct Current Motor Drives:** Controlled Rectifier Fed dc Drives, Single Phase Fully Controlled Rectifier Control of dc Separately Excited Motor.	
	14	Single Phase Half Controlled Rectifier Control of dc Separately Excited Motor.	
	15	Three Phase Fully Controlled Rectifier Control of dc Separately Excited Motor, Three Phase Half Controlled Rectifier Control of dc Separately Excited Motor.	
	16	Multi quadrant Operation of dc Separately Excited Motor Fed Form Fully Controlled Rectifier.	

	17	Rectifier Control of dc Series Motor, Supply Harmonics.	
	18	Power Factor and Ripple in Motor Current.	
	19	Chopper Control of Separately Excited dc Motor.	
	20	Chopper Control of Series Motor.	
3	21, 22	**Induction Motor Drives:** Analysis and Performance of Three Phase Induction Motors.	20
	23	Operation with Unbalanced Source Voltage and Single Phasing.	
	24	Operation with Unbalanced Rotor Impedances.	
	25, 26	Analysis of Induction Motor Fed From Non-Sinusoidal Voltage Supply.	
	27	Starting, Braking, Transient Analysis.	
	28	Speed Control Techniques-Stator Voltage Control.	
	29, 30	Variable Voltage Frequency Control from Voltage Sources.	
4	31	**Induction Motor Drives (continued):** Voltage Source Inverter (VSI) Control.	20
	32	Cyclo converter Control.	
	33	Closed Loop Speed Control.	
	34	Converter Rating for VSI and Cyclo converter Induction Motor Drives.	
	35	Variable Frequency Control from a Current Source.	
	36	Current Source (CSI) Control.	
	37	Current regulated voltage source inverter control.	
	38	Speed control of single phase induction motors.	
	39	**Synchronous Motor Drives:** Operation from fixed frequency supply-starting.	
	40	Synchronous motor variable speed drives, and variable frequency control of multiple synchronous motors.	
5	41	**Synchronous Motor Drives (continued):**Self-controlled synchronous motor drive employing load commutated thyrister inverter.	20
	42	Starting Large Synchronous Machines, Permanent Magnet ac (PMAC) Motor Drives.	
	43	Sinusoidal PMAC Motor Drives, Brushless dc Motor Drives.	
	44	**Stepper Motor Drives**: Variable Reluctance, Permanent Magnet	
	45	Important Features of Stepper Motors, Torque Versus Stepping rate Characteristics	
	46	Drive Circuits for Stepper Motor.	
	47	**Industrial Drives:** Textile Mills	
	48	Steel Rolling Mills.	
	49	Cranes and Hoists.	
	50	Machine Tools.	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: Questions on module 1	Students study basics of drives.	Module 1 of the syllabus	3	Individual Activity.	G K Dubey Vedum Subrahmanyam
2	Assignment 2: Questions on module 2	Students study the modeling and analysis of drives.	Module 2 of the syllabus	5	Individual Activity.	G K Dubey Vedum Subrahmanyam
3	Assignment 3: Questions on module 3	Students study the behavior of induction motor drive.	Module 3 of the syllabus	8	Individual Activity.	G K Dubey Vedum Subrahmanyam
4	Assignment 4: Questions on module 4	Students study the behavior of synchronous motor drive.	Module 4 of the syllabus	10	Individual Activity.	G K Dubey S K Pillai
5	Assignment 5: Questions on module 5	Students Study industrial applications.	Module 5 of the syllabus	12	Individual Activity.	G K Dubey N.K De, P.K. Sen

14.0 Assignment Questions

Assignment No	Questions	Marks
I	1. What is an Electric Drive? Explain the classification of Electric Drives with merits and demerits of each.	5marks
	2. Discuss the various factors governing selection of motors for a drive system.	5marks
	3. Distinguish between an electric motor and an electric drive. What are the methods by which power is transmitted from the motor to the driven unit?	5marks
	4. Compare the advantages of individual drive with group drive.	5marks
	5. Differentiate between passive and active torques with illustration. Establish the criteria for steady state stability of electric drives.	5marks
II	1. Explain how the rating of a motor can be selected for a continuous duty variable load based on the equivalent current method.	5marks
	2. What is heating & cooling time constants? Explain how the rating of a motor is affected by the temperature rise.	5marks
	3. Derive the expression used for the short time rating of a machine. Sketch the temperature rise Vs time curve.	5marks
	4. State and explain the important features of various braking methods of dc motors.	5marks
	5. Draw the speed torque characteristic for dynamic braking operation of dc series motor. Why torque becomes zero at finite speed?	5marks
	6. Explain with diagrams the operation of 3 phase full controlled rectifier control of dc separately excited motor.	5marks
III	1. What are the disadvantages of induction motor operation with unbalanced supply voltages?	5marks
	2. A squirrel cage induction motor is to be fed from a non-sinusoidal supply. It is preferred to use a motor with large leakage reactance. Why?	5marks
	3. Why stator voltage control is suitable for speed control of IM in fan and pump drives?	5marks
	4. Why stator voltage control is an inefficient method of IM speed control.	5marks
	5. Why is the p.f of the slip power recovery scheme of speed control of IM low?	5marks
IV	1. Explain IM drive control using VSI.	5marks
	2. Briefly discuss cycloconverter control and closed loop speed control with respect to IM drives.	5marks
	3. Explain variable frequency control from a current source.	5marks
	4. Explain speed control of single phase induction motor.	5marks
V	1. How do you start a synchronous motor?	5marks
	2. What is basic difference between true synchronous mode and self control made for variable frequency control of synchronous motor?	5marks
	3. Explain self controlled synchronous motor drive employing load commutated thyrister inverter.	5marks
	4. What you mean by continuous hot rolling mills & continuous cold rolling mills?	5marks
	5. Compare between line shaft drive and sectional drive.	5marks
	6. Mention the motors used for different textile mills.	5marks

15.0 QUESTION BANK

MODULE 1

1. What is an Electric Drive? Explain the classification of Electric Drives with merits and demerits of each.
2. Discuss the various factors governing selection of motors for a drive system.
3. Distinguish between an electric motor and an electric drive. What are the methods by which power is transmitted from the motor to the driven unit?
4. Compare the advantages of individual drive with group drive.
5. Differentiate between passive and active torques with illustration. Establish the criteria for steady state stability of electric drives.
6. What are advantages of electrical drives?
7. State essential parts of electrical drives. What are the functions of power modulator?
8. Write a brief note on the motors employed in variable speed drives.
9. State and explain the functions of various converters.
10. Write a brief note on the sources employed in electric drives.

11. What are main factors which decide the choice of electric drive for a given application?
12. What is the current status of dc and ac drives?
13. Explain what do you understand by the steady state stability? What is the main assumption?
14. Explain that the steady state stability of a drive depends on relative characteristic of the motor and load and not just on motor (or load) characteristic.
15. What are the reasons for using load equalization in electric drive?
16. Explain the operation of a hoist motor driving a hoist motor with four quadrant speed – torque diagram

MODULE 2

1. With usual notations find an expression for the temperature rise of a machine. Sketch the temperature rise Vs time curve.
2. Explain how the rating of a motor can be selected for a continuous duty variable load based on the equivalent current method.
3. What is heating & cooling time constants? Explain how the rating of a motor is affected by the temperature rise.
4. What is meant by rating of motors? Discuss how the type and size of motors for intermittent loads is determined.
5. Derive the expression used for the short time rating of a machine. Sketch the temperature rise Vs time curve.
6. Explain the classification of duty for motors with load diagrams. Mention one example in each case.
7. Derive the expression used for the short time rating of a machine. Sketch the temperature rise Vs time curve.
8. Derive the expression used for the intermittent rating of a machine. Sketch the temperature rise Vs time curve.
9. Derive the expression used for the moment of inertia of a flywheel.
10. Develop expression to determine power ratings of electric motors under the following applications.
    i. Continuous duty and constant load, Continuous duty and variable load
11. Explain how the rating of a motor can be selected for a continuous duty variable load based on the equivalent torque and power method.
12. Explain how the rating of a motor can be selected for a continuous duty variable load based on the average losses method.
13. A fully controlled rectifier is feeding separately excited dc motor is required to operate in motoring and breaking operations in the forward direction. Only one fully controlled rectifier is available. What switching arrangement will be required? Explain.
14. A fully controlled rectifier is feeding a separately excited motor driving a friction load. Motor is operating in a steady state with a rectifier firing angle is 30 deg. Firing angle is now changed from 30 deg to 60deg. Explain how motor current and speed will change with time.
15. Describe relative merits & demerits of four quadrant dc drives employing non circulating and circulating current dual converters.

MODULE 3

1. What are the advantages of squirrel cage induction motor over dc motor?
2. What are the main features of following type of induction motors:
    a) Deep bar rotor squirrel cage induction motor
    b) Double rotor squirrel cage induction motor
    c) Torque motor.
3. What is single phasing? Why should it be avoided?
4. What are the disadvantages of induction motor operation with unbalanced supply voltages?
5. What are the drawbacks associated with the operation of induction motor with unbalanced rotor impedances.
6. A squirrel cage induction motor is to be fed from a non-sinusoidal supply. It is preferred to use a motor with large leakage reactance. Why?
7. Why high current inrush occurs during open circuit transition in star delta and autotransformer starters of induction motor.
8. What do you understand by soft start? State and explain the soft start methods employed for induction motors.
9. Explain that the rotor resistance starters allow fast start with less heating of induction motor.
10. When operating in regenerative braking, the induction motor slip should not be allowed to exceed the breakdown slip why?

MODULE 4

1. A 3 phase wound rotor IM with external resistors in the rotor is running at light load. The supply to one of the 3 phases is disconnected. Whether the motor continues to run or stops will depend on the value of rotor resistance why?
2. When plugging is employed for stopping an IM, why is it necessary to disconnect it from supply when the speed reaches close to zero?
3. Why stator voltage control is suitable for speed control of IM in fan and pump drives?

4. Why stator voltage control is an inefficient method of IM speed control.
5. Why is the p.f of the slip power recovery scheme of speed control of IM low?
6. Why single winding single phase IM does not have starting torque.

MODULE 5

1. Why a synchronous motor does not have starting torque?
2. How do you start a synchronous motor?
3. What is basic difference between true synchronous mode and self control made for variable frequency control of synchronous motor?
4. What are the similarities between brushless dc motor and conventional dc motor? Why is it known as brushless dc motor? What are its advantages over a conventional dc motor?
5. What you mean by reversing hot rolling mills & reversing cold rolling mills?
6. What you mean by continuous hot rolling mills & continuous cold rolling mills?
7. Mention types of drives used for paper machine.
8. Compare between line shaft drive and sectional drive.
9. Mention the motors used for different textile mills

16.0 University Result

Examination	FCD	FC	SC	% Passing
2017-18	00	06	48	98.21
2016-17	04	14	43	100
2015-16	23	22	10	100

Prepared by	Checked by		
29.01.19	31/1	31.1.19	
Mr. Sagar S Birade	Mr. Keshav B Negalur	HOD	Principal

Subject Title	**SMART GRID**		
Subject Code	15EE831	**IA Marks**	20
Number of Lecture Hrs / Week	05 L	**Exam Marks**	80
Total Number of Lecture Hrs	40	**Exam Hours**	03

FACULTY DETAILS:		
Name: Prof.M.P.Yanagimath	**Designation:** Asst.Professor	**Experience:** 13
No. of times course taught: 01	**Specialization:** VLSI and ES	

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

- To define smart grid and discuss the progress made by different stakeholders in the design and development of smart grid.
- To explain the measurement techniques using PMUs and smart meters.
- To discuss tools for the analysis of smart grid and design, operation and performance.
- To discuss incorporating performance tools such as voltage and angle stability and state estimation into smart grid.
- To discuss classical optimization techniques and computational methods for smart grid design, planning and operation.
- To discuss the development of predictive grid management and control technology for enhancing the smart grid performance.
- To discuss development of cleaner, more environmentally responsible technologies for the electric system.
- To discuss the fundamental tools and techniques essential to the design of the smart grid.
- To describe methods to promote smart grid awareness and enhancement.
- To discuss methods to make the existing transmission system smarter by investing in new technology.■

3.0 Course Outcomes

After successful completion of the course, student will be able to

CO	Course Outcome	Cognitive Level	POs
1	Explain the architectural design, Communication and measurement technology and performance analysis tools for smart grid.	L3	1,2,3,4,5,6,8, 9, 10,12
2	Discuss various stability analysis tools for smart grid..	L4	1,2,3,4,5,6,8, 9, 10,12
3	Explain computational tools and pathways for designing smart grid.	L4	1,2,3,4,5,6,8, 9, 10,12
4	Develop cleaner, more environmentally responsible technologies for the electric system.	L2	1,2,3,4,5,6,8, 9, 10,12
5	Explain methods to promote smart grid awareness and making the existing transmission system smarter by investing in new technology.	L2	1,2,3,4,5,6,8, 9, 10,12
Total Hours of instruction		**40**	

4.0 Course Content

Module-1

Smart Grid Architectural Designs: Introduction, Today's Grid versus the Smart Grid, Energy Independence and Security Act of 2007: Rationale for the Smart Grid, Computational Intelligence, Power System Enhancement, Communication and Standards, Environment and Economics, General View of the Smart Grid Market Drivers, Stakeholder Roles and Function, Working Definition of the Smart Grid Based on Performance Measures, Representative Architecture, Functions of Smart Grid Components.

Smart Grid Communications and Measurement Technology: Communication and Measurement, Monitoring, PMU, Smart Meters, and Measurements Technologies, GIS and Google Mapping Tools, Multiagent Systems (MAS) Technology, Microgrid and Smart Grid Comparison.

Performance Analysis Tools for Smart Grid Design: Introduction to Load Flow Studies, Challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods, Load Flow State of the Art: Classical, Extended Formulations, and Algorithms, Congestion Management Effect, Load Flow for Smart Grid Design, DSOPF Application to the Smart Grid, Static Security Assessment (SSA) and Contingencies, Contingencies and Their Classification, Contingency Studies for the Smart Grid.

08 Hours

Module-2

Stability Analysis Tools for Smart Grid: Introduction to Stability, Strengths and Weaknesses of Existing Voltage stability Analysis Tools, Voltage Stability Assessment, Voltage Stability Assessment Techniques, Voltage Stability Indexing, Analysis Techniques for Steady-State Voltage Stability Studies, Application and Implementation Plan of Voltage Stability, Optimizing Stability Constraint through Preventive Control of Voltage Stability, Angle Stability Assessment, State Estimation.

08 Hours

Module-3

Computational Tools for Smart Grid Design: Introduction to Computational Tools, Decision Support Tools, Optimization Techniques, Classical Optimization Method, Heuristic Optimization, Evolutionary Computational Techniques, Adaptive Dynamic Programming Techniques, Pareto Methods, Hybridizing Optimization Techniques and Applications to the Smart Grid, Computational Challenges.

Pathway for Designing Smart Grid: Introduction to Smart Grid Pathway Design, Barriers and Solutions to Smart Grid Development, Solution Pathways for Designing Smart Grid Using Advanced Optimization and Control Techniques for Selection Functions, General Level Automation, Bulk Power Systems Automation of the Smart Grid at Transmission Level, Distribution System Automation Requirement of the Power Grid, End User/Appliance Level of the Smart Grid, Applications for Adaptive Control and Optimization.

08 Hours

Module-4

Renewable Energy and Storage: Renewable Energy Resources, Sustainable Energy Options for the Smart Grid, Penetration and Variability Issues Associated with Sustainable Energy Technology, Demand Response Issues, Electric Vehicles and Plug-in Hybrids, PHEV Technology, Environmental Implications, Storage Technologies, Tax Credits.

Interoperability, Standards, and Cyber Security: Introduction, Interoperability, Standards, Smart Grid Cyber Security, Cyber Security and Possible Operation for Improving Methodology for Other Users.

08 Hours

Module-5

Research, Education, and Training for the Smart Grid: Introduction, Research Areas for Smart Grid Development, Research Activities in the Smart Grid, Multidisciplinary Research Activities, Smart Grid Education, Training and Professional Development.

Case Studies and Test beds for the Smart Grid: Introduction, Demonstration Projects, Advanced Metering, Micro-grid with Renewable Energy, Power System Unit Commitment (UC) Problem, ADP for Optimal Network Reconfiguration in Distribution Automation, Case Study of RER Integration, Test-beds and Benchmark Systems, Challenges of Smart Transmission, Benefits of Smart Transmission.

08 Hours

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project	

6.0 Relevance to Real World

SL.No	Real World Mapping
01	More efficient transmission of electricity.
02	Reduced operations and management costs for utilities.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Expert Lecture	"Smart Grid"

8.0 Books Used and Recommended to Students

Text Books
Smart Grid, Fundamentals of Design and Analysis, James Momoh, Wiley. 1st Edition, 2012.
Additional Study material & e-Books
1. Research Papers on smart grid.

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

Website and Internet Contents References
1) nptel.ac.in
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/

11.0 Examination Note

Internal Assessment: 20 Marks

Three internal assessment tests will be conducted. Out of the three tests, average marks of the best two tests marks will be considered. The students will write the internal assessment tests in separate IA test books.

Scheme of Evaluation for Internal Assessment (25 Marks)

Two questions to be set for 12.5 mark each. Student has to answer for both the questions. There will be two sub-questions of 6 and 6.5 marks for each main question. However, there will be an alternate optional question for each sub-question.

Unit No.	Lecture No.	Content of Lecture	% of Portion
I	1.	**Smart Grid Architectural Designs**: Introduction, Today's Grid versus the Smart Grid, Energy Independence and Security Act of 2007: Rationale for the Smart Grid	20
	2.	Computational Intelligence, Power System Enhancement, Communication and Standards, Environment and Economics, General View of the Smart Grid Market Drivers	
	3.	Stakeholder Roles and Function, Working Definition of the Smart Grid Based on Performance Measures, Representative Architecture, Functions of Smart Grid Components.	
	4.	**Smart Grid Communications and Measurement Technology:** Communication and Measurement, Monitoring, PMU, Smart Meters, and Measurements Technologies	
	5.	GIS and Google Mapping Tools, Multiagent Systems (MAS) Technology, Microgrid	

		and Smart Grid Comparison.	
	6.	**Performance Analysis Tools for Smart Grid Design:** Introduction to Load Flow Studies, Challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods	
	7.	Load Flow State of the Art: Classical, Extended Formulations, and Algorithms, Congestion Management Effect, Load Flow for Smart Grid Design	
	8.	DSOPF Application to the Smart Grid, Static Security Assessment (SSA) and Contingencies, Contingencies and Their Classification, Contingency Studies for the Smart Grid.	
II	9.	**Stability Analysis Tools for Smart Grid:** Introduction to Stability, Strengths and Weaknesses of Existing Voltage stability Analysis Tools.	**20**
	10.	Voltage Stability Assessment	
	11.	Voltage Stability Assessment Techniques	
	12.	Voltage Stability Indexing,	
	13.	Analysis Techniques for Steady-State Voltage Stability Studies	
	14.	Application and Implementation Plan of Voltage Stability	
	15.	Optimizing Stability Constraint through Preventive Control of Voltage Stability	
	16.	Angle Stability Assessment, State Estimation	
III	17.	**Computational Tools for Smart Grid Design:** Introduction to Computational Tools, Decision Support Tools, Optimization Techniques	**20**
	18.	Classical Optimization Method, Heuristic Optimization, Evolutionary Computational Techniques	
	19.	Adaptive Dynamic Programming Techniques, Pareto Methods, Hybridizing Optimization Techniques and Applications to the Smart Grid, Computational Challenges.	
	20.	**Pathway for Designing Smart Grid:** Introduction to Smart Grid Pathway Design, Barriers and Solutions to Smart Grid Development	
	21.	Solution Pathways for Designing Smart Grid Using Advanced Optimization and Control Techniques for Selection Functions	
	22.	General Level Automation, Bulk Power Systems Automation of the Smart Grid at Transmission Level	
	23.	Distribution System Automation Requirement of the Power Grid, End User/Appliance Level of the Smart Grid	
	24.	Applications for Adaptive Control and Optimization.	
IV	25.	**Renewable Energy and Storage:** Renewable Energy Resources, Sustainable Energy Options for the Smart Grid	**20**
	26.	Penetration and Variability Issues Associated with Sustainable Energy Technology	
	27.	Demand Response Issues, Electric Vehicles and Plug-in Hybrids, PHEV Technology	
	28.	Environmental Implications, Storage Technologies, Tax Credits.	
	29.	**Interoperability, Standards, and Cyber Security:** Introduction	
	30.	Interoperability	
	31.	Standards, Smart Grid Cyber Security	
	32.	Cyber Security and Possible Operation for Improving Methodology for Other Users	
V	33.	**Research, Education, and Training for the Smart Grid:** Introduction, Research Areas for Smart Grid Development	**20**
	34.	Research Activities in the Smart Grid, Multidisciplinary Research Activities	
	35.	Smart Grid Education, Training and Professional Development.	
	36.	**Case Studies and Test beds for the Smart Grid:** Introduction, Demonstration Projects	
	37.	Advanced Metering, Micro-grid with Renewable Energy, Power System Unit Commitment (UC) Problem	
	38.	ADP for Optimal Network Reconfiguration in Distribution Automation, Case Study of RER Integration	
	39.	Test-beds and Benchmark Systems, Challenges of Smart Transmission	
	40.	Benefits of Smart Transmission.	

12.0 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.	Text Book 1of the 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.	Text Book 1 of the list.
3	Assignment3: University Questions onAutomatic 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.	Text Book 1 of the list.
4	Assignment 4: university Questions Voltage and Reactive Power Control	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity.	Text Book 1 of the list.
5	Power System Reliability and Security & State estimation of Power Systems	Students study the Topics and write the Answers. Get practice to solve university questions.	module 5 of the syllabus	10	Individual Activity.	Text Book 1 of the list.

13.0 QUESTION BANK

MODULE -1

1. Compare today's Grid versus the Smart Grid.
2. Show the general view of the Smart Grid Market Drivers.
3. Discuss about Smart Meters, and Measurements Technologies.
4. Explain about challenges to Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods.
5. Describe Classical, Extended Formulations, and Algorithms.
6. Explain DSOPF Application to the Smart Grid.
7. Write a note on Static Security Assessment (SSA) and Contingencies.
8. Describe the Contingency Studies for the Smart Grid.

MODULE -2

1. Explain about the Strengths and Weaknesses of Existing Voltage Stability Analysis Tools.
2. Discuss about various Voltage Stability Assessment Techniques.
3. Describe Analysis Techniques for Steady-State Voltage Stability.
4. Explain application and Implementation Plan of Voltage Stability.
5. Discuss about Optimizing Stability Constraint through Preventive Control of Voltage Stability.
6. Write a note on Angle Stability Assessment and State Estimation.

MODULE -3

1. Explain various computational Tools for Smart Grid Design.
2. Describe Adaptive Dynamic Programming Techniques.

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3. Discuss about Hybridizing Optimization Techniques and Applications to the Smart Grid.
4. With neat figure explain distribution system automation requirements of the power grid.
5. Show the classification of Distribution system management.

MODULE -4

1. Describe penetration and variability issues associated with sustainable energy technology.
2. Describe demand response issues.
3. Write a note on environmental implications.
4. Compare different storage technology options in smart grid.
5. Describe smart grid cyber security.

15.0 University Result

Examination	FCD	FC	SC	% Passing

Prepared by	Checked by		
Shri.Mahesh Yanagimath	Shri.V.B.Dhare	5.2.19 HOD	Principal