III Year II semester

S.No.	Course Code	Course	Hour /Week			
			L	T	P/D	C
1	OE118	Hybrid Electric Vehicles	3	-	-	3
2	EC 151	Microprocessors and Interfacing	4	-	-	4
3	EE 110	Power Electronics	4	-	-	4
4	EE 111	Power System Operation and Control	4	1	-	4
5	EE 112	Solar Thermal PV Systems	3	-	-	3
6	EC 152	Microprocessors and Interfacing Lab	-	-	3	2
7	EE 117	Induction Motors and Synchronous Machines Lab	-	-	3	2
8	EE 118	Power Electronics and Simulation Lab	-	-	3	2
Total						**24**

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Course Plan

Semester: **6 - Semester**	Year: **2019**
Course Title: **Hybrid Electric Vehicles**	Course Code: **OE118**
Semester End Examination: **70**	Continuous Internal Evaluation: **10**
Lesson Plan Author: Dr. Rajender B	Last Modified Date: 12-04-2018

Course Outcomes (COs):

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

1. Recall the history of hybrid and electric vehicles, its social and environmental importance.

2. Discuss the basics of vehicle performance, mathematical models for good vehicles performance. Illustrate the impact of modern drive trains on energy supplies.

3. Assess the electric propulsion unit configuration and control of various drives.

4. Analyze the energy storage requirements in hybrid, electric vehicles and various energy storage devices.

5. Apply the knowledge of energy management strategies which are used in hybrid and electric vehicles with different strategies for good efficiency design and performance.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Title: Hybrid Electric Vehicles	Semester: 6 - Semester
Course Code: OE118	Year: 2019

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1. Recall the history of hybrid and electric vehicles, its social and environmental importance.		**2**				**3**	**3**								
2.Discuss the basics of vehicle performance, mathematical models for good vehicles performance. Illustrate the impact of modern drive trains on energy supplies.	**3**	**2**											**3**		
3. Assess the electric propulsion unit configuration and control of various drives.			**2**										**3**		
4. Analyze the energy storage requirements in hybrid, electric vehicles and various energy storage devices.		**3**					**2**							**3**	
5. Apply the knowledge of energy											**3**	**3**			

management strategies which are used in hybrid and electric vehicles with different strategies for good efficiency design and performance.															

Course Content	Hrs
Unit - 1	
Introduction to Hybrid Electric Vehicles History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.	7.00 hrs
Unit - 2	
Hybrid Electric Drive-Trains Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.	7.00 hrs
Unit - 3	
Electric Propulsion Unit Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	7.00 hrs
Unit - 4	
Energy Storage Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based	8.00 hrs

energy storage and its analysis, Hybridization of different energy storage devices. Sizing the Drive System: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.	
Unit - 5	
Energy Management Strategies Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.	7.00 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. Chrismi,Abdul Masrur and David Wenzhang gao, Hybrid Electric Vechicles: principles and Applications with practical perspectives, I, Wiley, 2011

References

1. Iqbal Hussein, Electric and Hybrid Vechicles: Design Fundamentals, Ist, CRC Press, 2003

2. James Larminie,John Lowry, Electric Vehicle Technology Explainefd, Ist, Wiley, 2003

Chapter wise Plan

Course Code and Title: **OE118 / Hybrid Electric Vehicles**	
Chapter Number and Title: **1 - Introduction to Hybrid Electric Vehicles**	Planned Hours: **7.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Recall the history of Hybrid and Electric Vehicles	CO1	L1
2	Summarize the social and environmental importance of hybrid and electric vehicles.	CO1	L2

3	Analyze the impact of modern drive trains on energy supplies	CO2	L4
4	Classify various vehicle performance characteristics.	CO2	L2
5	Apply Mathematical models to describe vehicle performance.	CO2	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. History of hybrid and electric vehicles	01-01-1970	01-01-1970
2. Social and Environmental importance of HEV	01-01-1970	01-01-1970
3. Impact of modern drive trains on energy supplies	01-01-1970	01-01-1970
4. Basics of vehicle performance	01-01-1970	01-01-1970
5. Vehicle power source characterization	01-01-1970	01-01-1970
6. Transmission Characteristics	01-01-1970	01-01-1970
7. Mathematical models to describe vehicle performance	01-01-1970	01-01-1970
Review Questions		
Sl.no Questions	CO's	BL
1. "The Electric Vehicles have emerged and failed in 1990s" – Interpret the given statement in your own words and provide at least five reasons for failure of EVs.	CO1	L2
2. a) List at least five components (or parts) of Electric / Hybrid Electric Vehicles in which Electric Motor can be adopted. b) List all the possible configurations of Parallel Hybrid Electric Vehicles.	CO2	L3
3. Distinguish the Torque-Speed (T-N) and Power-Speed (P-N) characteristics of an Internal Combustion Engine (ICE) driven vehicle with the T-N & P-N characteristics of an Electric Vehicle.	CO1	L2
4. Explain History of hybrid and electric vehicles?	CO1	L1

5. Describe the mathematical models to vehicle performance?	CO2	L3

Course Code and Title: **OE118 / Hybrid Electric Vehicles**	
Chapter Number and Title: **2 - Hybrid Electric Drive-Trains**	Planned Hours: **7.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Explain the basic concepts of hybrid traction.	CO2	L2
2	Classify various hybrid drive train topologies.	CO2	L2
3	Analyze power flow control and fuel efficiency.	CO2	L4
4	Explain the basic concepts of Electric Traction.	CO2	L2
5	Classify various electric drive train topologies	CO2	L2

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
8. Basic concepts of hybrid traction	01-01-1970	01-01-1970
9. Introduction to various hybrid drive train topologies	01-01-1970	01-01-1970
10. Power control in hybrid drive train topologies	01-01-1970	01-01-1970
11. Fuel efficiency analysis	01-01-1970	01-01-1970
12. Basic concepts of electric traction	01-01-1970	01-01-1970
13. Introduction to various electric drive train topologies	01-01-1970	01-01-1970
14. Power flow control fuel efficiency of electric drive trains	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	CO's	BL
1. Explain the basic concepts of hybrid traction.	CO2	L2
2. Classify various hybrid drive train topologies.	CO2	L2
3.Analyze power flow control and fuel efficiency.	CO2	L4
4.Explain the basic concepts of Electric Traction.	CO2	L2
Course Code and Title: **OE118 / Hybrid Electric Vehicles**		
Chapter Number and Title: **3 - Electric Propulsion Unit**	Planned Hours: **7.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Listing various electric components used in HEV.	CO3	L1
2	Classifying configurations of dc motor drives and induction motor drives.	CO3	L2
3	Classifying various configurations of PM drives and SRM drives.	CO3	L2
4	Analyze the control of dc motor and induction motor drives	CO3	L4
5	Analyze the control of PM drives and SRM drives	CO3	L4

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
15. Introduction to electric components used in HEV	01-01-1970	01-01-1970
16. Configuration of DC and induction motor drives for HEV	01-01-1970	01-01-1970
17. Control of DC motor drives for HEV	01-01-1970	01-01-1970

18. Control of induction motor drives for HEV	01-01-1970	01-01-1970
19. Configuration and control of PM motor drives for HEV	01-01-1970	01-01-1970
20. Configuration and control of SRM drives for HEV	01-01-1970	01-01-1970
21. Drive system efficiency	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	CO's	BL
1.Listing various electric components used in HEV.	CO3	L1
2.Classifying configurations of dc motor drives and induction motor drives.	CO3	L2
3.Classifying various configurations of PM drives and SRM drives.	CO3	L2
4.Analyze the control of dc motor and induction motor drives	CO3	L4
5.Analyze the control of PM drives and SRM drives	CO3	L4

Course Code and Title: **OE118 / Hybrid Electric Vehicles**	
Chapter Number and Title: **4 - Energy Storage**	Planned Hours: **8.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Outline energy storage requirements in HEV.	CO4	L2
2	Choose appropriate energy storage device for HEV	CO4	L3
3	Analyze battery, fuel cell, super capacitor and fly wheel based energy storage devices	CO4	L4
4	Evaluate hybridization of different energy storage devices for HEV	CO4	L5
5	Select appropriate sizing of various components in HEV	CO4	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
22. Introduction to Energy storage requirements in HEV	01-01-1970	01-01-1970
23. Battery based energy storage and its analysis	01-01-1970	01-01-1970
24. Fuel cell based energy storage and its analysis - part 1	01-01-1970	01-01-1970
25. Fuel cell based energy storage and its analysis - part 2	01-01-1970	01-01-1970
26. Super capacitor based energy storage and its analysis	01-01-1970	01-01-1970
27. Flywheel based energy storage and its analysis, Hybridization of different energy storage devices	01-01-1970	01-01-1970
28. Matching electric machine and ICE, sizing of propulsion motor	01-01-1970	01-01-1970
29. Sizing of power electronic devices, selection of supporting subsystems	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	CO's	BL
1.Outline energy storage requirements in HEV.	CO4	L2
2.Choose appropriate energy storage device for HEV	CO4	L3
3.Analyze battery, fuel cell, supercapacitor and fly wheel based energy storage devices	CO4	L4
4.Evaluate hybridization of different energy storage devices for HEV	CO4	L5
5.Select appropriate sizing of various components in HEV	CO4	L3

Course Code and Title: **OE118 / Hybrid Electric Vehicles**	
Chapter Number and Title: **5 - Energy Management Strategies**	Planned Hours: **7.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Explain various energy management strategies for HEV	CO5	L2
2	Classify various EMS for HEV.	CO5	L2
3	Compare different EMS for HEV	CO5	L2
4	Interpret the implementation issues of energy management strategies.	CO5	L2
5	Judge the best HEV available in the market.	CO5	L5

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
30. Introduction to energy management strategies used in HEV	01-01-1970	01-01-1970
31. Classification of energy management strategies	01-01-1970	01-01-1970
32. Classification of few more energy management strategies	01-01-1970	01-01-1970
33. Comparison of different energy management strategies	01-01-1970	01-01-1970
34. Implementation issues of energy management strategies	01-01-1970	01-01-1970
35. Revision 1	01-01-1970	01-01-1970
36. Revision 2	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	CO's	BL
1.Explain various energy management strategies for HEV	CO5	L2
2.Classify various EMS for HEV.	CO5	L2
3.Compare different EMS for HEV	CO5	L2
4.Interpret the implementation issues of energy management strategies.	CO5	L2
5.Judge the best HEV available in the market.	CO5	L5

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Course Plan

Semester: **6 - Semester**	Year: **2019**
Course Title: **Microprocessors and interfacing**	Course Code: **EC151**
Semester End Examination: **70**	Continuous Internal Evaluation: **10**
Lesson Plan Author: Ms. MADHURI GUMMINENI	Last Modified Date: 02-12-2018

Course Outcomes (COs):

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

1. Describe the architecture of 8085 and 8086 microprocessors
2. Demonstrate i/o and memory interfacing of 8086 microprocessor
3. Analyze interrupt and serial communication operation of 8086 microprocessor
4. Describe the architecture of 8051 microcontroller
5. Design and implement microprocessor/microcontroller-based system

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Title: Microprocessors and interfacing	Semester: 6 - Semester
Course Code: EC151	Year: 2019

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1. Describe the architecture of 8085 and 8086 microprocessors	**3**														
2. Demonstrate i/o and memory interfacing of 8086 microprocesor	**3**														
3. Analyze interrupt and serial communication operation of 8086 microprocessor	**3**														
4. Describe the architecture of 8051 microcontroller	**3**			**3**											
5. Design and implement microprocessor/microcontroller-based system				**3**									**3**		

Course Content	Hrs
Unit – 1	
Chapter No. 1 - 8086 Evaluation of Microprocessors, Over View of 8085 8086 Architecture: Functional Diagram, Register Organization, Addressing modes, Instructions, Functional schematic, Minimum and Maximum mode operations of 8086, 8086 Control signal interfacing, Timing Diagrams. Assembly Language Programming of 8086: Assembly Directives, Macro's, Simple Programs using Assembler, Implementation of FOR Loop, WHILE, REPEAT and IF-THENELSE Features	15.00 hrs
Unit – 2	
Chapter No. 2 - I/O and Memory Interface I/O and Memory Interface: 8086 System bus structure, Memory and I/O Interfacing with 8086, 8255 PPI, Various modes of operations and interface of I/O devices to 8086, A/D, D/A Converter Interfacing, need for DMA, 8057 DMA controller	10.00 hrs
Unit – 3	
Chapter No. 3 - Interrupts	8.00 hrs

Interrupts: Interrupts in 8086, Interrupt vector table, dedicated interrupts, Interfacing 8259 (Interrupt Priority Control). Communication Interface: Serial Communication Standards, USART Interfacing RS-232, IEEE-488.	
Unit – 4	
Chapter No. 4 - Introduction to Micro Controllers Introduction to Micro Controllers: Overview of 8051 Micro Controller, Architecture, I/O ports and Memory Organization, Addressing modes and Instruction set of 8051, Simple Programs using Stack Pointer, Assembly language programming of 8051	8.00 hrs
Unit – 5	
Chapter No. 5 - Interrupts & Communication Interrupt Communication: Interrupts – Timer / Counter and Serial Communication, Programming Timer Interrupts, Programming External H/W interrupts, Programming the serial communication interrupts, Interrupt Priority in the 8051, Programming 8051 Timers, Counters and Programming	9.00 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. D.V. Hall,, Micro Processor and Interfacing, Tata McGraw Hill
2. Muhammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education

References

3. Ray and BurChandi, Advanced Micro Processors, Tata McGraw Hill
4. Liu and Gibson, Microcomputer Systems: The 8086/8088 Family: Architecture, Programming and Design, 2nd Edition, Pearson Education

Chapter wise Plan

Course Code and Title: **EC151 / Microprocessors and interfacing**	
Chapter Number and Title: **1 - 8086**	Planned Hours: **15.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Define the terms microprocessor, microcontroller, hardware and software.	CO1	L1

2	Describe how a microprocessor fetches and executes an instruction.	CO1	L2
3	List the registers and other parts in the 8086.	CO1	L1
4	Analyze addressing modes of 8086 and apply them in programming 8086	CO1	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Evaluation of Microprocessors, Over View of 8085	01-01-1970	01-01-1970
2. 8086 Architecture: Functional Diagram Execution and Bus Interface Unit	01-01-1970	01-01-1970
3. Register Organization	01-01-1970	01-01-1970
4. Addressing modes of 8086	01-01-1970	01-01-1970
5. Types of Instructions, Data Transfer, Arithmetic and Logical Instructions	01-01-1970	01-01-1970
6. 8086 Instructions: Branch instructions(Conditional and unconditional Branch)	01-01-1970	01-01-1970
7. Minimum and Maximum mode operations of 8086	01-01-1970	01-01-1970
8. Timing Diagrams	01-01-1970	01-01-1970
9. Simple Assembly Language Programming of 8086	01-01-1970	01-01-1970
10. Assembler Directives	01-01-1970	01-01-1970
11. Simple Programs using Assembler Directives	01-01-1970	01-01-1970
12. Procedures and Types of procedures	01-01-1970	01-01-1970
13. Recursive Procedures	01-01-1970	01-01-1970
14. Recursive procedure : Factorial of a number	01-01-1970	01-01-1970
15. Macros, Differences Between Procedures and Macros	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	TLOs	BL
1. List differences between 8bit and 16 bit microprocessor	TLO1	L1
2. Explain how Physical address is generated in 8086	TLO2	L2
3. What does mean by segmentation? List advantages of segmentation and why the size of segment in 8086 is limited to 64KB?	TLO4	L3

4. The register contents of 8086 is given below. CS=5000H, DS=6000H, SS=A000H, ES=B000H, SI=2000H, DI=3000H,BP=1002H,SP=0002H, AX=0000H, BX=5200H, CX=2000H, DX=2000HCalculate the effective address and physical address of the following instructions.(a) SUB AL, [SI](b) PUSH AX(c) AND AH, 42H [SI](d) SCASB(e) CMP DX, [SI] [BX]	TLO4	L3
Course Code and Title: **EC151 / Microprocessors and interfacing**		
Chapter Number and Title: **2 - I/O and Memory Interface**	Planned Hours: **10.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Define terms memory mapped I/O, I/O mapped I/O and DMA data transfer.	CO2	L1
2	Describe the operation of 8255 Programmable Peripheral Interface.	CO2	L2
3	Draw circuits showing how to interface input, output, A/D and D/A converters devices.	CO5	L3
4	Show how direct memory access (DMA) controller device can be connected in 8086 system and describe how a DMA data transfer takes place	CO2	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. 8086 System bus structure	01-01-1970	01-01-1970
2. Memory Interfacing with 8086	01-01-1970	01-01-1970
3. Need For I/O Interfacing	01-01-1970	01-01-1970
4. Programmable Peripheral interface 8255	01-01-1970	01-01-1970
5. I/O Interfacing Ana log to digital conversion	01-01-1970	01-01-1970
6. Digital to analog conversion	01-01-1970	01-01-1970
7. Stepper Motor Interface	01-01-1970	01-01-1970
8. Need For DMA , Data transfer Techniques	01-01-1970	01-01-1970
9. 8257 DMA controller	01-01-1970	01-01-1970

10. Interfacing 8257 with 8086:simple program on DMA Data transfer	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	TLOs	BL
1. What is the need of DMA?	TLO1	L1
2. Explain BSR mode of 8255 PPI	TLO2	L2
3. Design an interfacing diagram of interfacing DAC with 8086 through 8255 and then write a program to generate a ramp waveform.	TLO3	L3
4. Design hardware interface between 8086 and 8257	TLO5	L3
Course Code and Title: **EC151 / Microprocessors and interfacing**		
Chapter Number and Title: **3 - Interrupts**	Planned Hours: **8.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Describe the interrupt response of 8086 processor and initialize an 8086 interrupt vector table.	CO3	L1,L2
2	Describe the operation of an 8259 priority interrupt controller and write the instructions needed to initialize 8259 to a specific application	CO5	L2,L3,L4
3	Compare different modes of serial communication standards	CO3	L2,L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. What is interrupt, Interrupt structure of 8086	01-01-1970	01-01-1970
2. Interrupt Vector Table, Dedicated Interrupts of 8086	01-01-1970	01-01-1970
3. Interrupt driven data transfer ,Need for 8259	01-01-1970	01-01-1970
4. 8259 Programmable interrupt controller	01-01-1970	01-01-1970

5. ICWs and OCWs of 8259	01-01-1970	01-01-1970
6. Programming 8259,Interfacing 8259 with 8086	01-01-1970	01-01-1970
7. Serial communication standards,8251 USART	01-01-1970	01-01-1970
8. Parallel communication standards,IEEE-488 bus	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	TLOs	BL
1. List the Differences between I/O Interfacing and Memory Interfacing	TLO1	L1
2. Explain interrupt response sequence of 8086 microprocessor	TLO2	L2
3. Interface 8259Programable interrupt controller to 8086microprocessor	TLO2	L3
4. Differentiate synchronous and asynchronous serial communication	TLO3	L3
5. Draw and Explain the operation of 8251 USART	TLO3	L2
Course Code and Title: **EC151 / Microprocessors and interfacing**		
Chapter Number and Title: **4 - Introduction to Micro Controllers**	Planned Hours: **8.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	List features of 8051 microcontroller	CO4	L1
2	Describe the operation each block and function of each pin in 8051 .	CO4	L2
3	Analyze the addressing modes of 8051 and apply them in programming 8051	CO4	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Introduction to Micro Controllers	01-01-1970	01-01-1970
2. Overview of 8051 Micro Controller	01-01-1970	01-01-1970
3. I/O ports of 8051	01-01-1970	01-01-1970
4. Memory Organization of 8051 Internal RAM and ROM organization	01-01-1970	01-01-1970

5. Addressing Modes Of 8051	01-01-1970	01-01-1970
6. 8051 Instruction set	01-01-1970	01-01-1970
7. Stack Programming	01-01-1970	01-01-1970
8. Assembly language programming involving branch and loop instructions	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	TLOs	BL
1. List features of 8051 Microcontroller	TLO1	L1
2. Explain internal architecture of 8051 microcontroller.	TLO2	L2
3. Identify the addressing modes for the following set of instructions individually.(i) MOV A, 55H : (ii) MUL AB (iii) MOV R0, #54H(iv) MOVC A, @A+DPTR(v) MOV A, @R1	TLO3	
4. Write an 8051 μC ALP to add the first 20 natural numbers and store it in a RAM location	TLO3	L3
5. Explain the following pins of 8051.i. RST ii. EA iii. AD0-AD7 iv. T0	TLO2	L2
Course Code and Title: **EC151 / Microprocessors and interfacing**		
Chapter Number and Title: **5 - Interrupts & Communication**	Planned Hours: **9.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Describe the operation of timers/counters and serial communication.	CO4	L1,L2
2	Demonstrates the operation of I/O ports.	CO4	L2
3	Demonstrate the operation of interrupts.	CO4	L2
4	Initialize the resources with in the 8051 to perform specific task.	CO5	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Programmable timers and counters	01-01-1970	01-01-1970
2. producing delays using times/counters	01-01-1970	01-01-1970

3. Interrupt structure of 8051	01-01-1970	01-01-1970
4. Interrupt programming	01-01-1970	01-01-1970
4. Serial communication in 8051	01-01-1970	01-01-1970
5. serial communication programming	01-01-1970	01-01-1970
6. Interfacing switches and LED's	01-01-1970	01-01-1970
7. Keyboard interfacing	01-01-1970	01-01-1970
8. Stepper motor Interfacing	01-01-1970	01-01-1970
9. LCD Interfacing	01-01-1970	01-01-1970

Review Questions

Sl.No. - Questions	TLOs	BL
1. Draw the formats of TMOD, SCON registers	TLO1	L1
2. Write ALP to receive bytes serially from RXD and transmit received bytes serially through TXD at 4800 baud.	TLO1	L2
3. Explain how interrupts are handled in 8051.	TLO3	L2
4. Write a program to generate a square waveform of 20 ms at pin P1.4, for an 8051 with a clock frequency of 12MHz. Use Timer 0 in Mode 1.	TLO4	L3

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Course Plan

Semester: **6 - Semester**	Year: **2019**
Course Title: **Power Electronics**	Course Code: **EE123**
Semester End Examination: **70**	Continuous Internal Evaluation: **10**
Lesson Plan Author: Mr. Ramsha Karampuri	Last Modified Date: 21-11-2018

Course Outcomes (COs):

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

1. Suggest appropriate switches for specific applications
2. Evaluate performance indices of converters
3. Operate ac-dc three phase converters
4. Design the chopper circuits
5. Apply inverters for speed control of induction motors

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Title: Power Electronics	Semester: 6 - Semester
Course Code: EE123	Year: 2019

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1. Suggest appropriate switches for specific applications	**3**		**1**												
2. Evaluate performance indices of converters	**3**	**3**													
3. Operate ac-dc three phase converters	**3**	**2**													
4. Design the chopper circuits	**3**		**3**												
5. apply inverters for speed control of induction motors	**3**		**3**								**2**				

Course Content	Hrs
Unit - 1	
Chapter No. 1 - Power semiconductor devices and commutation techniques Thyristors – Silicon Controlled Rectifiers (SCR's) – BJT – Power MOSFET – Power IGBT and their characteristics and other thyristors – Basic theory of operation of SCR – Static characteristics – Turn on and turn off methods- Dynamic characteristics of SCR - Turn on and Turn off times -Salient points, Two transistor analogy .SCR - UJT firing circuit —– Series and parallel connections of SCR's – Snubber circuit details – Specifications and Ratings of SCR's, BJT, IGBT - Numerical problems – Line Commutation and Forced Commutation circuits.	19.00 hrs
Unit - 2	
Chapter No. 2 - single phase and three phase converters Phase control technique – Single phase Line commutated converters – Midpoint and Bridge connections – Half controlled converters with Resistive, RL loads and RLE load– Derivation of average load voltage and current -Active and Reactive power inputs to the converters without and with Freewheeling Diode –Numerical problems.Fully controlled converters, Midpoint and Bridge connections with Resistive, RL loads and RLE load– Derivation of average load voltage and current – Line commutated inverters -Active and Reactive power inputs to the converters without and with Freewheeling Diode, Effect of source inductance – Derivation of load voltage and current – Numerical problems.Three pulse and six pulse converters – Midpoint and bridge connections average load voltage With R and RL loads – Effect of Source inductance–Dual converters (both single phase and three phase) - Waveforms –Numerical Problems.	26.00 hrs
Unit - 3	
Chapter No. 3 - AC-AC voltage converters AC voltage controllers – Single phase two SCR's in anti-parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – Derivation of RMS load voltage, current and power factor waveforms – Firing circuits - Numerical problems - Cyclo converters – Single phase midpoint cyclo converters with Resistive and inductive load (Principle of operation only) – Bridge configuration of single phase cyclo-converter (Principle of operation only) – Waveforms	9.00 hrs
Unit - 4	
Chapter No. 4 - DC-DCchoppers Choppers – Time ratio control and Current limit control strategies – Step down	8.00 hrs

choppers Derivation of load voltage and currents with R, RL and RLE loads- Step up Chopper – load voltage expression. Morgan's chopper – Jones chopper and Oscillation chopper (Principle of operation only) Waveforms — AC Chopper – Problems.	
Unit - 5	
Chapter No. 5 - DC - AC converters Inverters – Single phase inverter – Basic series inverter – Basic parallel Capacitor inverter bridge inverter – Waveforms – Simple forced commutation circuits for bridge inverters – Mc Murray and Mc Murray – Bedford inverters - Voltage control techniques for inverters Pulse width modulation techniques – Numerical problems.	8.00 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. M. H. Rashid, Power Electronics: Circuits, Devices and Applications , second, Prentice Hall of India, 1998

2. M. D. Singh & K. B. Kanchandhani, Power Electronics, second, Tata Mc Graw Hill, 1998

References

3. Vedam Subramanyam, Power Electronics, New Age International (P) Limited

4. V.R.Murthy , Power Electronics, first, Oxford University Press, 2005

Chapterwise Plan

Course Code and Title: **EE123 / Power Electronics**	
Chapter Number and Title: **1 - Power semiconductor devices and commutation techniques**	Planned Hours: **19.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Understand the characteristics and applications of switches	CO1	L3
2	Apply turn-on and Turn-off methods to SCR	CO1	L3
3	Connect SCRs in series and parallel with respect to load demand	CO1	L1

4	Determine the specifications and ratings of SCR	CO1	L5
5	Design the protection circuit of SCR	CO1	L5

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Thyristors – Silicon Controlled Rectifiers (SCR's)	19/11/2018	
2. BJT – Power MOSFET	20/11/2018	
3. Power IGBT and their characteristics and other thyristors	23/11/2018	
4. Basic theory of operation of SCR	24/11/2018	
5. Static characteristics – Turn on and turn off methods	26/11/2018	
6. Dynamic characteristics of SCR - Turn on and Turn off times	27/11/2018	
7. Two transistor analogy	30/11/2018	
8. SCR - UJT firing circuit	01/12/2018	
9. Series and parallel connections of SCR's	03/12/2018	
10. Snubber circuit	04/12/2018	
11. Details, Specifications and Ratings of SCR's, BJT, IGBT	07/12/2018	
12. Line Commutation circuits	10/12/2018	
13. Forced Commutation circuits	11/12/2018	

Review Questions

Sl.No. - Questions	TLOs	BL
1. What have you learned about the importance of PE in the current scenario?	TLO1	L3
2. Compare the differences between MOSFET, IGBT and SCR	TLO1	L3
3. Analyze the necessity of Turn-on and Turn-off methods	TLO2	L3
4. Differentiate the series and parallel connections of SCRs with respect to their applications	TLO2	L3

Course Code and Title: **EE123 / Power Electronics**	
Chapter Number and Title: **2 - single phase and three phase converters**	Planned Hours: **26.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Analyze the operation of Full converters	CO2	L1,L2,L3
2	Understand the significance of freewheeling diode	CO2	L2,L3
3	Derive the voltage equations of DC to AC converters	CO2	L3,L4
4	Apply the converters to different loads	CO2	L3
5	Analyze the waveforms of three phase converters	CO3	L1,L2,L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Phase control technique	14/12/2018	
2. Single phase Line commutated converters	15/12/2018	
3. Mid point and Bridge connections	17/12/2018	
4. Half controlled converters with Resistive, RL loads and RLE load	18/12/2018	
5. Derivation of average load voltage and current	21/12/2018	
6. Active and Reactive power inputs to the converters without and with Freewheeling Diode	22/12/2018	
7. Fully controlled converters, Midpoint and Bridge connections with Resistive, RL loads and RLE load	24/12/2018	
8. Active and Reactive power inputs to the converters without and with Freewheeling Diode	28/12/2018	
9. Effect of source inductance – Derivation of load voltage and current	29/12/2018	

10. Three phase converters – Three pulse and six pulse converters	31/12/2018	
11. Mid point and bridge connections average load voltage With R and RL loads	11/12/2018	
12. Effect of Source inductance	04/01/2019	
13. Single phase and three-phase Dual converters	05/01/2019	

Review Questions

Sl.No. - Questions	TLOs	BL
1. Explain the operation of full converters for discontinuous mode	TLO1	L3
2. Compare the differences between semi and full converters	TLO3	L3
3. Analyze the operation of three phase converters	TLO5	L3
4. Derive the voltage equations of semi and full converters	TLO3	L3
5. Design a rectifier circuit with a minimum number of SCR\'s, for a continuous operating condition at any instant of time.	TLO4	L3
Course Code and Title: **EE123 / Power Electronics**		
Chapter Number and Title: **3 - AC-AC voltage converters**	Planned Hours: **9.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Analyze the operation of AC Voltage controller	CO3	L3
2	Understand the significance of TRIAC	CO3	L1,L3
3	Derive the voltage equations of AC tom AC Voltage converters	CO3	L3
4	Apply the cyclo converters to different loads	CO3	L3,L5
5	Compare different AC to AC voltage converters	CO3	L3,L4

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Single phase two SCR's in anti parallel – With R and RL load	07/01/2019	07/01/2019
2. Modes of operation of Triac	08/01/2019	08/01/2019
3. Triac with R and RL loads	11/01/2019	11/01/2019
4. Derivation of RMS load voltage, current and power factor	04/01/2019	04/01/2019
5. Cyclo converters	21/01/2019	21/01/2019
6. Single phase midpoint cyclo converters with Resistive and Inductive load	22/01/2019	22/01/2019
7. Bridge configuration of single phase cyclo converter	25/01/2019	25/01/2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. Draw the waveforms of AC voltage converter output for different loads	TLO1	L3
2. Analyze the modes of operation of TRIAC	TLO2	L3
3. Analyze the operation of cyclo converters step up and step down	TLO4	L3
4. Derive the voltage equations of AC to AC converters	TLO3	L3
Course Code and Title: **EE123 / Power Electronics**		
Chapter Number and Title: **4 - DC-DCchoppers**	Planned Hours: **8.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Analyze the operation of step up and step down Choppers	CO4	L3
2	Apply forced commutation techniques	CO4	L3,L4
3	Derive the voltage equations of DC to DC Voltage converters	CO4	L3,L4

4	Design Morgan's chopper	CO4	L3,L5
5	Design DC Jones chopper	CO4	L3,L5

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Choppers	28/01/2019	28/01/2019
2. Time ratio control and Current limit control strategies	29/01/2019	29/01/2019
3. Step down choppers	01/02/2019	01/02/2019
4. Derivation of load voltage and currents with R, RL and RLE loads	02/02/2019	02/02/2019
5. Step up Chopper	04/02/2019	04/02/2019
6. Load voltage expression	05/02/2019	05/02/2019
7. Morgan's chopper	08/02/2019	08/02/2019
8. DC Jones chopper (Principle of operation only) Waveforms	09/02/2019	09/02/2019
9. AC Chopper	11/02/2019	11/02/2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. Analyze the operation of basic step up and step down choppers	TLO1	L3
2. Apply suitable commutation circuits to turn off choppers	TLO2	L3
3. Design the circuit for DC Jones chopper	TLO4	L3
4. Derive the voltage equations of DC to DC converters	TLO3	L3
Course Code and Title: **EE123 / Power Electronics**		
Chapter Number and Title: **5 - DC - AC converters**	Planned Hours: **8.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Understand the operation of full bridge inverter	CO5	L2,L3
2	Apply different PWM techniques	CO5	L3,L5
3	Derive the THD value of half and full bridge inverters	CO5	L3,L5
4	Design Mc Murray Inverter	CO5	L3
5	Design Bedford Inverter	CO5	L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Single phase inverter	12/02/2019	12/02/2019
2. Basic series inverter	15/02/2019	15/02/2019
3. Basic parallel Capacitor inverter bridge inverter	16/02/2019	16/02/2019
4. Simple forced commutation circuits for bridge inverters	18/02/2019	18/02/2019
5. Mc Murray and Mc Murray Bedford inverters	19/02/2019	19/02/2019
6. Voltage control techniques for inverters	22/02/2019	22/02/2019
7. Pulse width modulation techniques	23/02/2019	23/02/2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. Analyze the operation of basic full bridge inverter	TLO1	L3
2. Apply suitable PWM techniques to inverters	TLO2	L3
3. Design the circuit for Mc Murray inverter	TLO4	L3
4. Derive the THD equations of DC to AC converters	TLO3	L3

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Course Plan

Semester: **6 - Semester**	Year: **2019**
Course Title: **POWER SYSTEM OPERATION CONTROL**	Course Code: **EE111**
Semester End Examination: **70**	Continuous Internal Evaluation: **10**
Lesson Plan Author: Mr. Venkataramana V	Last Modified Date: 01-12-2018

Course Outcomes (COs):

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

1. Formulate the report for optimal load dispatch schedule for a given load.
2. Model the speed governing system.
3. Construct the complete block diagram of a load frequency control system.
4. Determine the transient response of LFC.
5. Calculate the amount of reactive power to be compensated in a transmission system.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Title: POWER SYSTEM OPERATION CONTROL	Semester: 6 - Semester
Course Code: EE111	Year: 2019

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
1. Formulate the report for optimal load dispatch schedule for a given load.	**3**	**3**	3										**3**	
2. Model the speed governing system.	**2**	**2**	2										**2**	
3. Construct the complete block diagram of a load frequency control system.	**2**	**2**	2										**2**	
4. Determine the transient response of LFC.	**2**	**1**											2	
5. Calculate the amount of reactive power to be compensated in a transmission system.	**3**	**2**											2	

Content	Hrs
Unit - 1	
Chapter No. 1 - economic Objective of the course, Characteristics of Thermal Generators, Condition for Optimal Operation, Problems on Economic Dispatch by neglecting losses, Problems on Unit Limit Violation, Condition for Optimal dispatch by considering Losses-Coefficients formula Derivation, Flow Chart & Algorithm, Problems on ED Problem, Characteristics of Hyde units, Hydroelectric Power Plant models, Scheduling problems, Short term Hydrothermal scheduling, Problems on Hydro thermal scheduling.	16.00 hrs
Unit - 2	
Chapter No. 2 - modelling First order turbine model, Block diagram representation of steam turbines,Modeling of synchronous machine,Swing equation & State space II order model,Mathematical modeling of speed governing system,Fundamental Characteristic, excitation systems,IEEE Type-I model block diagram representation.	11.00 hrs
Unit - 3	
Chapter No. 3 - single Necessity of constant frequency,Control area concept,Single area control,Block diagram representation of an isolated Power System,Steady State response,Dynamic response of Un-controlled case,Problems on LFC,LFC of two-area systems,Block diagram of Two area system,Uncontrolled case,controlled case,Tie-line bias control	12.00 hrs
Unit - 4	
Chapter No. 4 - load PI Controller for single area,Steady state response,LFC and Economic dispatch control,LFC of 2 area system	9.00 hrs
Unit - 5	
Chapter No. 5 - reactive Over view of reactive power control,Compensation in transmission systems,Sources of reactive power,Advantages of different compensation equipment,Disadvantages of various compensation equipment,Load Compensation,Specifications of Load compensator,Uncompensated Transmission Lines,Shunt Compensation,Series Compensation	16.00 hrs

Chapter wise Plan

Course Code and Title: **EE111 / POWER SYSTEM OPERATION CONTROL**	
Chapter Number and Title: **4 - load**	Planned Hours: **9.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Build PI Controller for single area	CO5	L3
2	produce LFC and Economic dispatch control	CO5	L1
3	design LFC of 2 area system	CO5	L6
4	desribe Steady state response	CO5	L2

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. PI Controller for single area	30-01-2019	30-01-2019
2. Steady state response	04-02-2019	04-02-2019
3. Economic dispatch control	28-01-2019	28-01-2019
4. Load Frequency Control	24-01-2019	24-01-2019
5. Load Frequency Control (cont.)	25-01-2019	25-01-2019
6. Economic dispatch control (cont.)	29-01-2019	29-01-2019
7. PI Controller for single area(cont.)	31-01-2019	31-01-2019
8. PI Controller for single area (cont.)	01-02-2019	01-02-2019
9. Steady state response(cont.)	05-12-2018	05-12-2018

Review Questions

Sl.No. - Questions	TLOs	BL
1. design the block diagrams of single area and two area control system	TLO1	L6
2. build PI control for two area load frequency control system	TLO1	L3

Course Code and Title: **EE111 / POWER SYSTEM OPERATION CONTROL**	
Chapter Number and Title: **1 - economic**	Planned Hours: **16.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Explain the role of the characteristics of thermal generators in economic dispatch problem	CO1	L2,L3
2	Calculate optimal loading of thermal generators to meet the power demand	CO2	L4
3	derive B-Coefficients formula	CO2	L4
4	solve Problems on ED Problem	CO2	L3
5	discuss Short term Hydrothermal scheduling	CO2	L2

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Objective of the course	19-11-2018	19-11-2018
2. Optimal operation of Generators in Thermal Power Stations	20-11-2018	20-11-2018
3. heat rate Curve – Cost Curve	22-11-2018	22-11-2018
4. Incremental fuel and Production costs, input-output characteristics	23-11-2018	23-11-2018
5. Optimum generation allocation with line losses neglected.	26-11-2018	26-11-2018
6. Optimum generation allocation with line losses neglected (cont.)	27-11-2018	27-11-2018
7. Optimum generation allocation including the effect of transmission line losses	28-11-2018	28-11-2018
8. Optimum generation allocation including the effect of transmission line losses (cont.)	29-11-2018	29-11-2018

9. Loss Coefficients, General transmission line loss formula.	30-11-2018	30-11-2018
10. Loss Coefficients, General transmission line loss formula. (cont.)	03-12-2018	03-12-2018
11. Hydroelectric power plant models	04-12-2018	04-12-2018
12. Hydroelectric power plant models (cont.)	05-12-2018	05-12-2018
13. scheduling problem	06-12-2018	06-12-2018
14. scheduling problem (cont.)	07-12-2018	07-12-2018
15. scheduling problems Short term hydrothermal scheduling problem.	10-12-2018	10-12-2018
16. scheduling problems Short term hydrothermal scheduling problem.(cont.)	10-12-2018	10-12-2018

Review Questions

Sl.No. - Questions	TLOs	BL
1. develope the condition for economic operation by considering losses using flow chart and algorithm	TLO2	L4
2. develope the condition for optimum operation of a power system with n plants	TLO1	L3
Course Code and Title: **EE111 / POWER SYSTEM OPERATION CONTROL**		
Chapter Number and Title: **2 - modelling**	Planned Hours: **11.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	draw the block diagram of steam turbine	CO3	L3,L6
2	discuss the function of excitation system	CO4	L2
3	develope the IEEE type 1 excitation system	CO4	L6

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. First order turbine model	12-12-2018	12-12-2018
2. Block diagram representation of steam turbines	13-12-2018	13-12-2018
3. Modeling of synchronous machine	14-12-2018	14-12-2018
4. Swing equation & State space II order model	18-12-2018	18-12-2018
5. Mathematical modeling of speed governing system	20-12-2018	20-12-2018
6. Fundamental Characteristic, excitation systems	24-12-2018	24-12-2018
7. IEEE Type-I model block diagram representation	28-12-2018	28-12-2018
8. Modeling of synchronous machine (cont)	17-12-2018	17-12-2018
9. Swing equation & State space II order model (cont.)	19-12-2018	19-12-2018
10. Mathematical modeling of speed governing system (cont.)	21-12-2018	21-12-2018
11. Fundamental Characteristic, excitation systems (cont.)	27-12-2018	27-12-2018

Review Questions

Sl.No. - Questions	TLOs	BL
1. design the block diagram representation of IEEE type 1 model	TLO1	L6
2. construct the block diagram of steam turbine	TLO1	L3
Course Code and Title: **EE111 / POWER SYSTEM OPERATION CONTROL**		
Chapter Number and Title: **3 - single**	Planned Hours: **12.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	explain Single area load frequency control	CO6	L2,L3
2	solve the Problems on Load frequency control	CO6	L3
3	summarize the cncept of Dynamic response of Un-controlled case	CO6	L4

4	explain Uncontrolled case and controlled case of two area control	CO6	L2,L3

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Necessity of constant frequency	31-12-2018	31-12-2018
2. Control area concept	02-01-2019	02-01-2019
3. Single area control	03-01-2019	03-01-2019
4. Block diagram representation of an isolated Power System	04-01-2019	04-01-2019
5. Steady State response	07-01-2019	07-01-2019
6. Dynamic response of Un-controlled case	08-01-2019	08-01-2019
8. LFC of two-area systems	09-01-2019	09-01-2019
10. Uncontrolled case	21-01-2019	21-01-2019
11. controlled case	22-01-2019	22-01-2019
12. Tie-line bias control	23-01-2019	23-01-2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. explain objectives of load frequency control ,discuss relation between LFC and load frequency control	TLO1	L2
2. develop the controlled case and uncontrolled case of two area load frequency control	TLO4	L3
3. Develop the block diagram of a single area system of Load Frequency control?	TLO1	L3
Course Code and Title: **EE111 / POWER SYSTEM OPERATION CONTROL**		
Chapter Number and Title: **5 - reactive**	Planned Hours: **16.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	recall the Compensation in transmission systems	CO7	L1
2	explain the Sources of reactive power	CO8	L2
3	compare the advantages of different compensation equipments	CO7	L3,L4
4	list the differences between Shunt Compensation and Series Compensation	CO7	L1

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Over view of reactive power control	06-02-2019	06-02-2019
2. Compensation in transmission systems	08-02-2019	08-02-2019
3. Advantages of different compensation equipment	12-02-2019	12-02-2019
4. Disadvantages of various compensation equipment	13-02-2019	13-02-2019
5. Load Compensation	14-02-2019	14-02-2019
6. Specifications of Load compensator	15-02-2019	15-02-2019
7. Uncompensated Transmission Lines	18-02-2019	18-02-2019
8. Shunt Compensation	20-02-2019	20-02-2019
9. Series Compensation	25-02-2019	25-02-2019
10. Over view of reactive power control (cont.)	07-02-2019	07-02-2019
11. Compensation in transmission systems (CONT.)	11-02-2019	11-02-2019
12. Shunt Compensation (cont.)	21-02-2019	21-02-2019
13. Shunt Compensation (Cont.2)	22-02-2019	22-02-2019
14. Series Compensation(cont.)	26-02-2019	26-02-2019
15. Series Compensation (cont2.)	27-02-2019	27-02-2019
16. Uncompensated Transmission Lines (cont.)	19-02-2019	19-02-2019

Review Questions

Sl.No. - Questions	TLOs	BL

1. list the types of load compensation techniques and overview of reactive power control	TLO1	
2. develop the series and shunt equipments	TLO3	L3

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Course Plan

Semester: **6 - Semester**	Year: **2019**
Course Title: **SOLAR THERMAL PV SYSTEMS**	Course Code: **EE112**
Semester End Examination: **70**	Continuous Internal Evaluation: **10**
Lesson Plan Author: Mr. K Dhanraj	Last Modified Date: 01-12-2018

Course Outcomes (COs):

At the end of the course, students will develop ability to

1. Estimation of Solar Radiation on Hourly, Daily and Seasonal basis.
2. Discuss Thermal Analysis of Solar Collectors.
3. Evaluate the performance of PV system.
4. Classify solar cells and solar modules.
5. Explain Economic Analysis of Solar Energy using different methods.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Title: SOLAR THERMAL PV SYSTEMS	Semester: 6 - Semester
Course Code: EE112	Year: 2019

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
1. Estimation of Solar Radiation on Hourly, Daily and Seasonal basis.	2	1			3								2	
2. Discuss Thermal Analysis of Solar Collectors.	1		3		2									2
3. Evaluate the performance of PV system.	1		3	2	2								2	1
4. Classify solar cells and solar modules.			2	1										1
5. Explain Economic Analysis of Solar Energy using different methods.	2	3		1										1

Course Content	Hrs
Unit - 1	
Chapter No. 1 - Solar Radiation Nature of Solar Radiation, Global, Beam and Diffuse Radiation, Hourly, Daily and Seasonal variation of solar Radiation, Estimation of Solar Radiation, Measurement of Solar Radiation	8.00 hrs
Unit - 2	
Chapter No. 2 - Photo Thermal Systems Flat Plate Collector, Hot Air Collector, Evacuated Tube Collector, Parabolic , Compound Parabolic and Fresnel Solar Concentrators, Central Receiver System, Thermal Analysis of Solar Collectors Performance of Solar Collectors, Solar Water Heating Systems (Active and Passive), Solar Space Heating and Cooling Systems, Solar Industrial Process Heating Systems, Solar Dryers and Desalination Systems, Solar Thermal Power Systems	11.00 hrs
Unit - 3	
Chapter No. 3 - Photovoltaic Systems Solar cells and panels, performance of solar cell, estimation of power obtain from solar power, solar panels PV systems, components of PV systems, performance of PV systems, design of PV systems, applications of PV systems, concentrating PV systems, PV power plants, power plant with fuel cells.	9.00 hrs
Unit - 4	
Chapter No. 4 - Design and Modeling of Solar Energy Systems F Chart method, φ– F Chart method, Utilizability modeling and simulation of Solar Energy Systems.	5.00 hrs
Unit - 5	
Chapter No. 5 - Economic Analysis of Solar Energy Systems Life cycle analysis of Solar Energy Systems, Time Value of Money, Evaluation of Carbon Credit of Solar Energy Systems.	6.00 hrs

Text Books (List of books as mentioned in the approved syllabus)

1. . J.A. Duffie and W.A. Beckman, Solar Engineering of Thermal Process, 4, John Wiley and Sons, 2013

2. S.A. Kalogirou, Solar Energy Engineering, 2, Academic Press, 2014

References

1. Mukherjee and Thakur, Photo Voltaic Systems Analysis and Design, Eastern Economy Edition, PHI, 2012

2. C.S Solanki, Solar Photovoltaics - Fundamentals, Technologies and ApplicationsSolar Photovoltaics - Fundamentals,, Economy Edition, PHI, 2012

Chapterwise Plan

Course Code and Title: **EE112 / SOLAR THERMAL PV SYSTEMS**	
Chapter Number and Title: **1 - Solar Radiation**	Planned Hours: **8.00 hrs**

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	identify Hourly, Daily and Seasonal variation of solar Radiation	CO1	L3
2	Estimate the available Solar Radiation	CO1	L6
3	choose the Solar Radiation measuring instruments.	CO1	L1
4	Summarize the knowledge of solar radiation data	CO1	L2

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Nature of Solar Radiation	19-11-2018	19-11-2018
2. Global, Beam and Diffuse Radiation	19-11-2018	19-11-2018
3. Hourly, Daily and Seasonal variation of solar Radiation	20-11-2018	20-11-2018

4. Hourly, Daily and Seasonal variation of solar Radiation	24-11-2018	24-11-2018
5. Estimation of Solar Radiation	26-11-2018	26-11-2018
6. Estimation of Solar Radiation data	27-11-2018	27-11-2018
7. Introduction of Measurement of Solar Radiation	01-12-2018	01-12-2018
8. Types of Measurement of Solar Radiation	03-12-2018	03-12-2018
9. Brief overview of unit 1	04-12-2018	04-12-2018

Review Questions

Sl.No. - Questions	TLOs	BL
1. Discuss the techniques used for estimating solar radiation?	TLO2	L6
2. Explain the variation of solar energy on daily and hourly basis?	TLO4	L2
3. calculate Hourly, Daily and Seasonal variation of solar Radiation	TLO1	L3
Course Code and Title: **EE112 / SOLAR THERMAL PV SYSTEMS**		
Chapter Number and Title: **2 - Photo Thermal Systems**	Planned Hours: **11.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	choose the type of solar collectors for different applications.	CO2	L1
2	identify different types of Solar Collectors	CO2	L3
3	Compare Active and Passive solar Water Heating Systems	CO2	L2
4	elaborate applications of solar energy	CO2	L6

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Introduction of Photo Thermal Systems	10-12-2018	10-12-2018
2. Flat Plate Collectors	11-12-2018	11-12-2018

3. Hot Air Collectors	15-12-2018	15-12-2018
4. Evacuated Tube Collectors	17-12-2018	17-12-2018
5. Parabolic , Compound Parabolic and Fresnel Solar Concentrators	18-12-2018	18-12-2018
6. Central Receiver System	22-12-2018	22-12-2018
7. Thermal Analysis of Solar Collectors Performance of Solar Collectors	24-12-2018	24-12-2018
8. Solar Water Heating Systems (Active and Passive)	29-12-2018	29-12-2018
9. Solar Space Heating and Cooling Systems	31-12-2018	31-12-2018
10. Industrial Process Heating Systems	05-01-2019	05-01-2019
11. Solar Dryers and Desalination Systems	19-01-2019	19-01-2019
12. Solar Thermal Power Systems and review	19-01-2019	19-01-2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. implement different types of Solar Collectors	TLO2	L3
Course Code and Title: **EE112 / SOLAR THERMAL PV SYSTEMS**		
Chapter Number and Title: **3 - Photovoltaic Systems**	Planned Hours: **09.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Demonstrate the performance of solar cell	CO4	L3
2	Explain about Solar cells and panels	CO4	L2
3	Estimate the power obtained from solar energy	CO5	L6
4	classify the applications of PV systems	CO3	L4

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Introduction of Photovoltaic Systems	21-01-2019	21-01-2019
2. Solar cells and panels	22-01-2019	22-01-2019
3. performance of solar cell, estimation of power obtain from solar power,	26-01-2019	26-01-2019
4. solar panels PV systems, components of PV systems	28-01-2019	28-01-2019
5. performance of PV systems, design of PV systems	29-01-2019	29-01-2019
6. applications of PV systems	02-02-2019	02-02-2019
7. concentrating PV systems	04-02-2019	04-02-2019
8. PV power plants, power plant with fuel cells.	05,11-02-2019	05,11-02-2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. Estimate the power obtained from solar energy.	TLO3	L6
2. Sketch the solar cell and write in brief about it.	TLO1	L3
Course Code and Title: **EE112 / SOLAR THERMAL PV SYSTEMS**		
Chapter Number and Title: **4 - Design and Modeling of Solar Energy Systems**	Planned Hours: **05.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Discuss Solar Energy Systems	CO3	L2
2	Implement the Solar Energy Systems	CO3	L3
3	Develop Solar Energy Systems	CO3	L3
4	Compare methods for Design and Modelling of Solar Energy Systems	CO5	L5

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Introduction of Solar Energy Systems	12-02-2019	12-02-2019
2. Design and Modelling of Solar Energy Systems	12-02-2019	12-02-2019
3. Discuss about Design and Modelling of Solar Energy Systems using F Chart method	16-02-2019	16-02-2019
4. Discuss about Design and Modelling of Solar Energy Systems using φ– F Chart method	18-02-2019	18-02-2019
5. Utilizability modelling of Solar Energy Systems.	19-02-2019	19-02-2019
6. Utilizability modelling and simulation of Solar Energy Systems.Utilizability modelling and simulation of Solar Energy Systems.	23-02-2019	23-02-2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. Explain about Design and Modelling of Solar Energy Systems using φ– F Chart method?	TLO2	L2
2. Construct the Solar Energy Systems	TLO2	L3
Course Code and Title: **EE112 / SOLAR THERMAL PV SYSTEMS**		
Chapter Number and Title: **5 - Economic Analysis of Solar Energy Systems**	Planned Hours: **6.00 hrs**	

Learning Outcomes:-

At the end of the topic the student should be able to:

	Topic Learning Outcomes	COs	BL
1	Explain Economic Analysis of Solar Energy Systems	CO5	L2
2	Examine the Carbon Credit of Solar Energy Systems.	CO5	L3
3	Illustrate Life cycle analysis of Solar Energy Systems.	CO5	L2
4	Compare different analysis of Solar Energy Systems	CO5	L5

Lesson Schedule

Lecture No. - Portion covered per hour	Planned Delivery Date	Actual Delivery Date
1. Introduction of Economic Analysis of Solar Energy Systems	25-02-2019	25-02-2019
2. Life cycle analysis of Solar Energy Systems	26-02-2019	26-02-2019
3. Time Value of Money analysis of Solar Energy Systems	02-03-2019	02-03-2019
4. Evaluation of Carbon Credit of Solar Energy Systems	05-03-2019	05-03-2019
5. review	11,12-03-2019	11,12-03-2019

Review Questions

Sl.No. - Questions	TLOs	BL
1. explain about Economic Analysis of Solar Energy Systems	TLO1	L2
2. Demonstrate the Carbon Credit of Solar Energy Systems.	TLO2	L3