INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**MASTER OF TECHNOLOGY in ELECTRICAL ENGINEERING**
SEMESTER	**2**
COURSE TITLE	**DIGITAL CONTROL OF POWER ELECTRONIC SYSTEMS**
COURSE CODE	**01PE1201**
COURSE CREDITS	**4**

Objective:

1 To give a basic knowledge of the digital control techniques applied to power converters, and to raise the interest for discrete time control, stimulating new developments in its application to switching power converters.

Course Outcomes: After completion of this course, student will be able to:

1 Compare the discrete control and continuous control of converters.
2 Analyze and compare various digital control techniques.
3 Apply various design approach for digital controller design.
4 Implement the basic digital current control of Power electronic converter.

Pre-requisite of course:NA

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Introduction to Digital Control** Why Digital control, Advantages of Digital Control, Disadvantages of Digital Control and New Trends,, Relationship of continuous Time Signals and discrete Samples,, Structure of continuous control and discrete control,, Review of continuous control, Continuous Vs. Discrete relationships.	4
2	**Digital control Design Approach** Digital via Emulation, Direct Digital Approach,, Root Locus Approach, Bode Plot or Frequency Response Approach,, Deadbeat Control, Raggazini's Controller Design Method,, State-Space Design: State Feedback Design, State Estimator Design.	12

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Contents : Unit	Topics	Contact Hours
3	**Digital Current Mode control** Requirements of the Digital Controller, Basic Digital Current Control Implementations,, The Proportional Integral Controller: Discretization Strategies,, Effects of the Computation Delay, Derivation of a Discrete Time Domain Converter, Dynamic Model and Minimization of the Computation Delay,, The Predictive Controller, Space Vector Modulation Based Controllers,, Rotating Reference Frame Current Controller, Design of voltage controller.	12
4	**Digital Control Techniques** Digital Current Mode Control,, Predictive Control, Sliding Mode Control, Space Vector Control, Fuzzy Control,, Pulse Train Control Method	8
5	**Applications of Digital Control** PWM generation Techniques: Pulse Width Modulation,, Naturally Sampled PWM, Regularly Sampled PWM and Randomly Sampled PWM,, Motor Drives, Power Factor Correction,, Standby Power Supply with Active Power Filter Ability,, Distributed Power Systems, DC-DC Converters, Electronic Ballasts.	8
Total Hours		**44**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment No .01** Compare and Analyse bode plots with different dynamic system.	2
2	**Experiment No .02** Plot the root locus of the transfer function using MATLAB.	2
3	**Experiment No .03** Simulate closed loop control of dc-to-dc converter using PI controller.	2
4	**Experiment No .04** Simulate & observe the voltage control mode of buck converter using MATLAB.	2
5	**Experiment No .05** Observe current control mode of buck converter with different duty cycle.	2
6	**Experiment No .06** Simulate & observe the performance of voltage control mode of boost converter.	2
7	**Experiment No .07** To Implement current control mode of boost Converter in simulation and observe its performance.	2
8	**Experiment No .08** To Implement current control mode of buck-boost Converter in simulation and observe its performance.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	**Experiment No .09** Simulate & observe the performance of current control mode of buck-boost Converter	2
Total Hours		**18**

Textbook :

1 Digital Control in Power Electronics, Simone Buso and Paolo Mattavelli,, Morgan & Claypool Publishers., NA

2 Digital Signal Processing in Power Electronics Control Circuits, Krzysztof Sozanski,, Springer London Heidelberg New York., NA

3 Integrated Power Electronic Converters and Digital Control, Ali Emadi, Alireza Khaligh, Zhong Nie, Young Joo Lee, CRC Press, Taylor & Francis Group., NA

References:

1 Digital control applications, Digital control applications, Hemchandra Madhusudan Shertukde, University of Hartford, CT, USA, -

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	10.00	25.00	30.00	20.00	10.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and classroom.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

1 https://archive.nptel.ac.in/courses/108/105/108105186/

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Supplementary Resources:

2 https://elearn.nptel.ac.in/shop/iit-workshops/completed/digital-controller-for-power-applications/?v=c86ee0d9d7ed

3 https://onlinecourses.nptel.ac.in/noc22_ee124/preview

4 https://elearn.nptel.ac.in/shop/iit-workshops/completed/digital-controller-for-power-applications-batch-2/?v=c86ee0d9d7ed

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