

GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS AND ELECTRICAL DRIVES

EMBEDDED CONTROL OF ELECTRIC DRIVES

SUBJECT CODE: 2734503

M.E. 3RD SEMESTER

Type of course: Engineering Science (ELECTRICAL)

Prerequisite: NA

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Interfacing of I/O devices in 8-bit Controller, Timer/Counter operation, Interrupts operation in 8-bit controllers Introduction to TMS320F28xxx DSP controller, architecture, peripherals, IQ math for fixed point presentation of floating point numbers	8	20%
2	32-bit Microcontroller and peripherals: General Purpose Input Output pins: Introduction, Multiplexing of I/O pins, Input qualification, Use of GPIO for control for converter Analog to Digital Conversion: Introduction, Internal structure of ADC in TMS320F28xxx, Auto conversion Sequencer Principle of Operation, Sequential and simultaneous sampling in ADC, Control word and application Event Manager: Operation of Timer in various modes, PWM/CMP Units and their operation, SVPWM unit, Capture unit, QEP circuit for speed measurement Interrupts: Peripheral Interrupt Expansion operation, Interrupt management and programming	12	30%
3	Implementation of Power Electronics Converter for Electrical Drives: AC/DC converter: Interfacing circuits for AC/DC converter, Zero crossing detection method, Algorithm development, Single phase half/fully controlled converter, Three phase converters and their control in open loop and closed loop mode DC/DC converter: Implementation of DSP algorithm in buck, boost and buck-boost converters, interfacing circuits, closed loop control DC/AC converter(Inverter): Control of VSI in six-step mode, Implementation of various PWM schemes with microcontroller, Implementation of SVPWM algorithm using PWM unit/SVPWM unit	12	30%

4	Closed loop control of Electric Drives Introduction to Digital Motor Control module of TMS320F28xxx DSP controller. Implementation of Clarke Transformation, Park transformation, Inverse park transformation, phase voltage calculation, speed controller, position controller, speed estimator, volt per hertz profile for AC motors.	8	20%
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Reference Books:

1. B.K. Bose , ‘Microcomputer control of Power Electronic and Drives’, IEEE Press –USA.
2. Hamid A. Toliyat, Steven. G. Campbell, “DSP-Based Electromechanical Motion Control”, CRC Press 2003.
3. Datasheet on ‘TMS320F28xxx DSP controller family’
4. Texas Instruments Inc., C2000 Systems and Applications-Digital Motor Control Library, version-13.2.

Course Outcome:

After learning the course the students should be able to:

1. Implement algorithms for control of electric drive.
2. Interface microcontroller with power electronics converters.
3. Develop closed loop controller with TMS320F28xxx

List of Experiments:

In laboratory duration student can be given following titles as an experiment.

1. Introduction to Integrated Development Environment for microcontroller
2. Programming of General Purpose Input Output in microcontroller.
3. Programming of Analog to Digital Converter in microcontroller
4. Programming of Interrupts for peripherals in microcontroller
5. Generation of fixed pulse width modulation using Timer/Compare Unit
6. Development of sine PWM and SVPWM for Inverters
7. Measurement of Speed using Compare/Capture/QEP unit of microcontroller.
8. Development of speed PI controller for closed loop operation

Design based Problems (DP)/Open Ended Problem:

Course coordinator has to define at least 3 open ended problems related to the course.

Major Equipment:

The necessary Kits, Breadboard, development boards, equipments, accessories and instruments are to be provided to conduct the above practical in a group of maximum four students.

List of Open Source Software/learning website:

- Code Composer Studio (CCS) Integrated Development Environment (IDE), Texas Instruments
- ControlSUITE™ Software, Texas Instruments

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.