SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. IV: Semester – 7

Subject Name: Industrial Drives & Control **Subject Code: BTIC14701**

Type of course: Professional Elective

Prerequisite (if any): Basic knowledge of power electronics, electronic circuits, circuit and network analysis, electrical machines

List of Courses where this course will be prerequisite: --

Rationale:

This course will provide the students (i) basics of control of electrical drives (ii) design and application of driver circuits for various machines (iii) speed control of some advance motors with microcontrollers.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

BSC: basic science course /ESC: Engineering Science Course /HSM: Humanities and management /PCC: Professional Core course /PEC: professional Elective course /OEC: Open Elective course/ MD: mandatory noncredit course

Content:

Sr. No.	Content	Total Hrs	%weightage
1	**Overview of DC motor and control** Basic operations types and applications of DC motor, speed control of DC motors, speed measurement, speed sensor, torque speed characteristics, field and armature voltage control, current control, Modeling of DC motors, transfer function and state space models.	06	13%
2	**DC motor drives** Closed loop speed control and analysis of DC motors, single phase and three phase converters for DC drives, computations of speed and firing angle, microcontrollers based designs, firing circuits for thyristors and MOSFETs. Pulse Width Modulation(PWM) and speed control, DC-DC chopper and its analysis for Continuous Current Mode and Discontinuous Current Mode of operations, duty cycle, critical duty ratio. Braking of DC motors, four quadrant operation with full and half MOSFET bridges.	10	22%
3	**Induction motor and drives** Induction motor and its operating principle, torque speed characteristics, pull out torque, slip, construction of induction motor, speed control strategies, design of inverters , Sine PWM inverters, unipolar and bipolar SPWM, six step inverters, Variable Voltage and Variable Frequency (VVVF) inverters, half and full bridge inverters , v/f control of induction motor, dq model, park transformation , vector control.	10	22%
4	**Stepper motors** Basics of stepper motor, types, principle of operation, torque speed	10	20%

	characteristics, stepper motor drives circuit design, unipolar and bipolar circuit design, microcontroller based speed control of stepper motors, ramped acceleration and deceleration, switching angle control, applications of stepper motors		
5	**Brushless DC motors and drives** Advantages of brushless DC motor over conventional DC motor, construction and principle of operation, applications of BLDC motors, PMSM motors, single phase and three phase BLDC motors, Hall position sensor, sensorless control of BLDC,	**9**	**18%**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20%	**20%**	**20%**	**20%**	**10%**	**10%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

Sr no	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Electric Motor Drives: Modeling, Analysis and Control	R.Krishnan	Pearson Education India • ISBN-10	2015	1st

			: 9789332549715		
2	Power Electronics	M. Rashid	Pearson Education • ISBN-10 : 9332584583	2017	4th
3	Power Electronics and Motor Control	W. Shepherd	Cambridge University Press • ISBN-10 : 0521478138	1996	2nd
4	Stepping motors	Paul Acarnley	IET control engineering series • ISBN-10 : 085296417X	2002	4th

Course Outcomes: after successful completion of this course the students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	apply the fundamentals of control theory to control ac/dc machines	20%
CO-2	apply the fundamentals of power electronics to design driver circuits	20%
CO-3	design speed controller for various electrical machines	20%
CO-4	chose electrical machine and control systems for industrial applications	10%

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CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3												2
CO2				2	2	2									2
CO3							2	2	2				1	2	
CO4										1	2	3	3		

List of learning website:

NPTEL, SWAYAM, EDX, Coursera websites

NPTEL lectures control systems design
List of Open Source Software: Scilab simulation software

FOR LAB SESSIONS:

List of Experiments:

1. Speed measurement of any machine with optocoupler speed sensor.
2. H Bridge driver circuits for DC motor speed and direction control with L293D.
3. Microcontroller based speed control of DC motor.
4. Open loop speed control of DC motor with single semi converter or full converter.
5. DC-DC converter design for speed control of DC motor.
6. Speed control of Induction motor with VFD drive.
7. Chopper based closed loop PI/PID control of DC motor with simulation.
8. Design/testing of PWM/SPWM inverter with available kit.
9. Stepper motor speed control with stepper motor driving card and PLC.
10. Stepper motor speed control with microcontroller and ULN 2003A IC.

Major Equipment Needed: Computer Lab **,** MATLAB/Scilab software

Op-Amps./microcontroller/other hardware setup for ac/dc drives.