SARVAJANIK UNIVERSITY
SarvajanikCollege of Engineering and Technology
Bachelor of Technology

B.Tech. Semester VI

Subject Name: Electrical Drives **Subject Code: BTEL13601**

Type of course: **Professional Core Course**
Prerequisite: Electrical Machine and Power Electronics
Rationale: Today's industrial and domestic loads demands precise and smooth variable speed control. In the era of renewable energy and electric vehicle the efficient electric drive required for DC and AC motors. The major industrial electric load is induction motor. The development of compact power converters has made this possible. This course enables to develop the basics of electric drives and advantage over conventional speed control methods.

Teaching and Examination Scheme:

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

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

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Fundamentals of Electric Drives** Electrical Drives, Advantages of electrical drives, parts of electrical drives, choice of electrical drives. Fundamental torque equation, Load torque components, Nature and classification of load torques, Steady state stability, Load equalization, Four quadrant operation of drive (hoist control), Braking methods: Dynamic, Plugging, Regenerative methods.	8	15
2.	**Controlled Converter fed DC Motor Drives** Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux	12	25

	weakening for high speed operation. 1-phase and 3-phase half and fully controlled converter fed separately and self-excited DC motor drive, Output voltage and current waveforms, Speed-torque expressions, Speed-torque characteristics, Principle of operation of dual converters and dual converter fed DC motor drives		
3.	**Chopper fed DC drive** Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor dynamic equations and transfer function.	8	20
4.	**Induction motor characteristics** Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.	7	15
5.	**Scalar control (constant V/f control) of induction motor and Control of slip ring induction motor** Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit. Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery schemes, Static Scherbius drive, Static Kramer drive, Performance and speed torque characteristics	10	25

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**30**	**20**	**25**	**10**	**0**

PCC: Professional Core Course

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

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

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Understand the fundamental of Electric Drives.	15
CO-2	Analyse the AC to DC controlled converter fed DC Drives.	25
CO-3	Understand the DC to DC chopper fed DC Drives.	20
CO-4	Acquire knowledge of various speed-torque characteristics of Induction motor.	15
CO-5	Understand the V/f control and slip power recovery schemes of Induction motor.	25

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	3	3	3		1	1	2	3	3	3	3	3	1
CO-2	3	3	3	3	3		2	2	2	3	3	3	3	3	
CO-3	3	3	3	3	3		2	2	2	3	3	3	3	3	
CO-4	3	3	3	3	3		2	2	2	3	3	3	3	3	
CO-5	3	3	3	3	3		2	2	2	3	3	3	3	2	
Rationale *															

Rationale*: Explaining why it is matching this particular program outcome

LIST OF PRACTICALS: (Minimum ------ performed.)

1. To study the fundamental and block diagram of Electric drive.
2. To simulate various N-T characteristics of separately excited DC motor drive.
3. To study and simulate modelling of separately excited DC motor drive.
4. To study and simulate 1-Φ Fully Controlled converter fed separately excited DC Motor drive.

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5. To study and simulate Two-quadrant operation of Controlled converter fed separately excited DC Motor drive.
6. To study and simulate Class- A chopper fed separately excited DC Motor drive.
7. To study and simulate Two-quadrant chopper fed separately excited DC Motor drive.
8. To simulate and plot the Speed-Torque characteristics of Induction Motor for:
   (a)Variable Frequency and Fixed voltage
   (b) Variable voltage and Fixed Frequency
9. To simulate and plot the Speed-Torque characteristics of V/f controlled Induction Motor for:
   (a) Constant Torque Region
   (b) Constant Power Region
10. To study and simulate AC voltage controller based speed control of Induction Motor Drive.

Reference Text Books:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.
5. Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education
6. Vedam Subrahmanyam, “Electric Drives”, TMH (I), Second Edition,
7. J.M.D. Murphy and F.G. Turnbull, “Power Electronics Control of AC Motors”, Peragmo
8. Theodore Wildi, “Electrical Machines, Drives and Power Systems”, sixth edition, Pearson

Major Equipment:

Simulation software like Scilab, MATLAB, PSIM etc. along with necessary toolbox.