Department of Electrical Engineering

Open Electives

Sem	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
III	OE-01	<*tbd*>	Electrical Installation & Practices	2	-	-	1	**2**	30	20	50	--	--
IV	OE -02	<*tbd*>	Electrical Machines and Drives	2	-	-	1	**2**	30	20	50	--	--
V	OE -03	<*tbd*>	Electric Vehicle Technology	2	-	-	1	**2**	30	20	50	--	--
			Total	**06**	**-**	**-**	**03**	**06**					

Detailed Syllabi

Electrical Installation & Practices						
Course Code			**Examination Scheme**			
Teaching Scheme	2-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	2		**Laboratory**	CIE: 00	ESE: 00	--

Course Outcomes: Students will be able to:

1. Explain different wiring systems, electrical accessories, and installation practices.
2. Apply IS standards and IE regulations in electrical installations and earthing systems.
3. Design basic lighting circuits and illumination schemes for buildings.
4. Prepare basic estimation and costing for domestic and commercial electrical installations.
5. Understand installation practices of power circuits, overhead lines, and substations with safety considerations.

Unit 1: Wiring Systems and Electrical Accessories **[5 Hrs]**

Introduction to electrical installation systems, Methods of wiring and selection of wiring systems, Wiring materials and accessories: Wires and cables, Conductors and insulating materials, Main switch and distribution boards, Lighting accessories and fittings, Protective devices: Fuse, MCB, RCCB, Energy meter and service mains, Relevant IS standards and IE rules.

Unit 2: Earthing and Electrical Safety Practices **[6 Hrs]**

Necessity and objectives of earthing, Types of earthing: Plate earthing, Pipe earthing, Equipment earthing, Earth resistance and factors affecting it, Methods of reducing earth resistance, Protection against electric shock, Lightning protection of buildings, Measurement of earth resistance, Electrical safety procedures and first aid practices.

Unit 3: Lighting Circuits and Illumination Practices **[6 Hrs]**

Lighting sub-circuits and power circuits, Types of lighting circuits, Bedroom and corridor lighting arrangements, Illumination terminology and laws of illumination, Indoor and street lighting schemes, Methods of lighting calculations, Energy-efficient lighting systems. Energy star ratings of appliances (ACs, Refrigerators). Understanding the electricity bill: Fixed charges, unit rates, and slab systems. Calculating the running cost of household/office equipment.

Unit 4: Power Backup & Renewable Energy **[6 Hrs]**

Batteries: Lead-acid and Li-ion basics. Selection and sizing of UPS and Inverters for home/office. Basics of Rooftop Solar PV systems: Components required and net-metering overview.

Unit 5: Installation Practices, Maintenance & Troubleshooting **[5 Hrs]**

Electrical installation for motor circuits, Selection of cables, starters, and protective devices, Basics of LT distribution systems and substations, Single-line diagram of electrical installation, Safety clearances and maintenance practices. Preventive vs. Breakdown maintenance. Common faults in home appliances and wiring. Guidelines for safe use of extension boards and heavy-load appliances. Basic tools for an electrical toolkit.

Textbooks:

[1]	J.B. Gupta — A Course in Electrical Installation Estimation and Costing
[2]	S.L. Uppal — Electrical Wiring Estimating and Costing
[3]	Raina & Bhattacharya — Electrical Design, Estimating and Costing

Reference Books:	
[1]	McPartland — Handbook of Practical Electrical Design
[2]	Stokes — Handbook of Electrical Installation Practice
[3]	National Electrical Code (NEC) / IS 732 / IS 3043

Electrical Machines and Drives						
Course Code			**Examination Scheme**			
Teaching Scheme	2-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	CIE: 50	ESE: 50	--

Course Outcomes: Students will be able to:

1. Understand basic operation of power electronic devices.
2. Identify common power converters and their applications.
3. Explain operation of DC motor drives.
4. Explain operation of AC motor drives.
5. Select suitable drives for simple practical applications

Unit 1: Power Electronics Devices	**[5 Hrs]**

Basics of power semiconductor devices, construction and working of Diode, SCR, Power MOSFET and IGBT, basic characteristics and simple triggering concept of SCR, comparison of MOSFET and IGBT, and applications of power devices in drives, solar systems and electric vehicles

Unit 2: Power Converters	**[6 Hrs]**

Basic concept of power conversion and classification of converters, AC–DC converters, DC–AC converters , DC–DC converters and AC-AC voltage controller operation with loads (R, RL), and applications in battery charging, solar power systems and UPS

Unit 3: Electrical Drive Selection and Applications	**[6 Hrs]**

Concept of electrical drive selection, factors affecting selection such as load characteristics, speed and power requirements, selection of motors for different applications i.e. electric vehicles and household appliances with emphasis on energy efficiency

Unit 4: DC Motor Drives	**[6 Hrs]**

Basic structure of electric drive, working principle of DC motor, torque-speed characteristics, methods of speed control (armature and field control), and applications of DC drives in industries such as cranes, elevators and electric vehicles.

Unit 5: Induction Motor Drives	**[5 Hrs]**

Working principle of induction motor, torque-speed characteristics, starting methods of squirrel cage motors, basic speed control methods, introduction to V/f control, and applications in fans, pumps and compressors

Textbooks:	
[1]	G.K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi , 2001.
[2]	Harish C.N.K.De and P. K. Sen, Electric Drives, PHI Learning Pvt. Ltd., New Delhi , 1999).
Reference Books:	
[1]	S. K. Pillai, A First Course in Electrical Drives, New Age International, New Delhi , 1994
[2]	Vedam Subrahmanyam, Electric Drives: Concepts and Applications, New Age International, New Delhi , 2005

e Learning Resources:	
https://archive.nptel.ac.in/courses/108/104/108104140/	
Note:	
[1] [2] [3] [4] [5]	To measure CO1, questions may be of the type- define, identify, state, match, list, name etc. To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc. To measure CO3, questions will be based on applications of core concepts. To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc. To measure CO5, some questions may be based on self-study topics and comprehension of unseen passages.

Electrical Vehicle Technology						
Course Code			**Examination Scheme**			
Teaching Scheme	2-0-0-1		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	2		**Laboratory**	CIE: 50	ESE: 50	--

Course Outcomes: Students will be able to:

1. Define matrices, linear equations, and determinants, recall basic matrix algebra, limits, continuity and derivatives of functions of single variable.
2. Solve a system of linear equations using matrices, verify MVTs, find Critical points and Monotonicity of functions of single variable.
3. Calculate eigen values, eigen vectors, rank of a matrix, find extreme values of functions.
4. Apply concepts of calculus to find extrema of functions, including real life problems.
5. Apply concepts of Matrix Algebra and Calculus to various problems including real life problems.

Unit 1: Overview of Electric Vehicles in India	**[5 Hrs]**
Can India Drive its EV program Innovatively and Differently and scale?, Can India Drive its EV program Innovatively and Differently and scale?, A bit about batteries, Charging and Swapping Infrastructure, Where will we get Lithium for batteries?, EV Subsystems	
Unit 2: Vehicle Dynamics	**[6 Hrs]**
Forces acting when a vehicle move, Aerodynamic drag, Rolling Resistance and Uphill Resistance, Power and Torque to accelerate, Putting it all together, Putting it all together, Concept of Drive Cycle.	
Unit 3: Vehicle Subsystems: EV Power-train	**[6 Hrs]**
Drive Cycles and Energy used per km, EV Subsystem: Design of EV Drive Train, Introduction to Battery Parameters, Why Lithium Ion Battery, Batteries in Future, Li-Ion Battery Cells.	
Unit 4: Fundamentals of EV Battery Pack Design	**[6 Hrs]**
SoH and SoC estimation and Self Discharge, SoH and SoC estimation and Self Discharge, Battery Pack Development, Computation of Effective cost of battery, Charging Batteries, Fundamentals of Battery Pack Design, Mechanical Design, Thermal Design, BMS Design of Electic Vehicle, EV Motors and Controllers - Understanding Flow.	
Unit 5: Battery Charging and Swapping	**[5 Hrs]**

Power and Efficiency, Torque Production, Speed and Back EMF, The d-q Equivalent circuit, Field-oriented Control, Battery Swapping, Standardization and On board Chargers, Economics of Public Chargers in context.	
Textbooks:	
[1]	Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication
e-courses:	
[1]	https://nptel.ac.in/courses/108106170
Note:	
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