STATE BOARD OF TECHNICAL EDUCATION, BIHAR

Scheme of Teaching and Examinations for

IVth SEMESTER DIPLOMA IN ELECTRICAL ENGINEERING/ ELECTRICAL & ELECTRONICS ENGINEERING.

(Effective from Session 2020-21 Batch)

THEORY

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME							
			Periods per Week	Hours of Exam.	Teacher's Assessment (TA) Marks A	Class Test (CT) MarksB	End Semester Exam. (ESE) Marks C	Total Marks (A+B+C)	Pass Marks ESE	Pass Marks in the Subject	Credits
1.	Power Electronics	2020401	03	03	10	20	70	100	28	40	03
2.	Electric Power Transmission and Distribution	2020402	03	03	10	20	70	100	28	40	03
3.	Induction, Synchronous and Special Electrical Machines	2020403	03	03	10	20	70	100	28	40	03
4.	Solar Power technologies	2020404	03	03	10	20	70	100	28	40	03
5.	Industrial drives	2020405	03	03	10	20	70	100	28	40	03
	Total: - 15						**350**	**500**			**15**

PRACTICAL

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME					
			Periods per Week	Hours of Exam.	Practical (ESE)		Total Marks (A+B)	Pass Marks in the Subject	Credits
					Internal(A)	External(B)			
6.	Power Electronics Laboratory	2020406	02 50% physical 50% Virtual	03	15	35	50	20	01
7.	Induction, Synchronous and Special Electrical Machines Laboratory	2020407	02 50% physical 50% Virtual	03	15	35	50	20	01
8.	Industrial Drives laboratory	2020408	02 50% physical 50% Virtual	03	07	18	25	10	01
9.	MATLAB	2020409	02 50% physical 50% Virtual	03	07	18	25	10	01
	Total: - 08						**150**		04

TERM WORK

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME				
			Periods per Week	Marks of Internal Examiner (X)	Marks of External Examiner (Y)	Total Marks (X+Y)	Pass Marks in the Subject	Credits
10.	Electric power transmission and distribution (T.W)	2020410	02	07	18	25	10	01`
11.	Solar power technologies (T.W)	2020411	02	07	18	25	10	01
12.	Course Under Moocs /SWAYAM/**AutoCAD** in electrical engineering or others	2020412	02	07	18	25	10	01
13.	Summer training/Industrial Visits	2020413	04	07	18	25	10	02
	Total: - 10					**100**		**05**
Total Periods per week Each of duration One Hour 33			Total Marks = **750**					**24**

POWER ELECTRONICS
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Theory						Credits
2020401	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To understand and acquire knowledge about various power semiconductor devices.
- Maintain the proper functioning of power electronic devices
- To analyze and design different power electronics circuits such as power converters, inverters, choppers etc.

CONTENTS: THEORY

Chapter	Name of the Topic	Hrs./Unit
Unit-I	**Power Electronic Devices** • Power electronic devices • Power transistor: construction, working principle, V-I characteristics and its applications. • FET & MOSFET: construction, working principle, V-I characteristics and its applications • IGBT: Construction, working principle, V-I characteristics and its applications.	04
Unit-II	**Thyristor Family Devices** • SCR: construction, types, working and its V-I characteristics. Two-transistor analogy, Protection circuits: Over-voltage, over-current, Snubber, Crowbar. • SCR mounting, cooling. &Rating • Thyristor family devices: symbol, construction, operating principle and V-I Characteristics of GTO, UJT, DIAC and TRIAC.	08
Unit-III	**Turn-on and Turn-off Methods of Thyristors** • SCR Turn-On methods: High Voltage triggering, thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering. • Gate trigger circuits – Resistance and Resistance-Capacitance circuits. • SCR triggering using UJT Relaxation Oscillator and Synchronized UJT circuit. • SCR Turn-Off methods: Natural and forced commutation, Class A- Series resonant commutation circuit, Class B-Shunt Resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit, Class D–Auxiliary commutation. (Only introduction derivation not required)	08
Unit-IV	**Phase Controlled Rectifiers** • Phase control: firing angle, conduction angle. • Single Phase Fully Controlled Half Wave Converter - With R, RL load with dc source: Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode. • Single-phase full- wave mid-point and bridge converter with R, RL load with dc source: Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode. • Single-phase semi converter with R, RL load with dc source: Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode.	16

	• Three-phase full converter with R, RL load with dc source: Circuit diagram, working, input- output waveforms, equations for DC output and effect of free wheeling diode. • Dual converter.	
Unit-V	**Chopper** – • Chopper Principle • Control Techniques: 1. Constant Frequency System 2.Variable Frequency System • Classification of Choppers: • Step Up Chopper & stepdown choppers with problems • Class A, Class B, Class C, Class D and Class E chopper • Commutation Methods for Choppers: Auxiliary Commutation & Load Commutation	04
Unit-VI	**Inverters** • Single Phase Bridge Inverter - Half Bridge Inverter - Full Bridge Inverter • Three phase bridge inverters • Three phase 180 Degree mode VSI Circuit diagram, working, input- output wave forms, equations • Three phase 120-Degree mode VSI Circuit diagram, working, input- output wave forms, equations • Series Inverter - Operation of Basic Series Inverter Circuit and its application. • Parallel Inverter - Operation of Basic Parallel Inverter Circuit. • Cycloconverters principle of operation, Input output waveforms.	08
	TOTAL	**48**

References:

1. An Introduction to Thyristor sand their applications, by M.Ramamoorty,East-West Press Pvt. Ltd., New Delhi, ISBN: 8185336679.
2. Thyristors: Theory and Applications, Sugandhi, Rajendra Kumar and Sugandhi, Krishna Kumar, New Age International(P) ltd. Publishers, New Delhi, ISBN:978-0-85226-852-0.
3. Power Electronics Circuits Devices and Applications by P.S. bhimbra
4. Fundamentals of Power Electronics, by S.K Bhattacharya, Vikas Publishing House Pvt. Ltd. Noida. ISBN:978- 8125918530.
5. Power Electronics and its Applications, by Jain & Alok,Penram International Publishing(India) Pvt. Ltd, Mumbai, ISBN: 978-8187972228.
6. Power Electronics Circuits Devices and Applications, by Muhammad Rashid, Pearson Education India, Noida, ISBN:978- 0133125900.
7. Power Electronics, byM.D. Singh, andK.B., Khan chandani, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2008ISBN: 9780070583894.
8. Z bar, Paul B., Industrial Electronics: A Text– Lab Manual, McGraw Hill Publishing Co. Ltd., New Delhi, ISBN: 978-0070728226.
9. Grafham D.R., SCR Manual, General Electric Co., ISBN:978-0137967711.
10. R N Duha , Power Electronics , FPH
11. R S Gupta , Fundamentals of Power Electronics , FPH

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented Cos associated with the above-mentioned competency:

a) Select power electronic devices for specific applications.

b) Maintain the performance of Thyristors.

c) Trouble shoot turn-on and turn-off circuits of Thyristors.

d) Maintain phase-controlled rectifiers.

e) Maintain industrial control circuits.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Theory						Credits
2020402	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To introduce the students to the general structure of the network for transmitting power from generating stations to the consumers.
- To expose the students to the different electrical & mechanical aspects of the power network along with its environmental and safety constraints
- Maintain the proper functioning of the electrical transmission and distribution systems.

CONTENTS: THEORY

Chapter	Name of the Topic	Hrs.
Unit-I	**Basics of Transmission and Distribution** Single line diagrams with components of the electric supply transmission and distribution systems. Classification of transmission lines: Primary and secondary transmission; standard voltage level used in India. Classification of transmission lines: based on the type of voltage, voltage level, length and others Characteristics of high voltage for power transmission. comparisons of transmission & distribution lines (methods of construction, ac and dc)	06
Unit-II	**Transmission Line Parameters and Performance** Line Parameters: Concepts of R, Land C of line parameters and types of lines. Skin effect, proximity effect and Transposition of conductors and its necessity. Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor, Numerical based on short transmission line. Performance of medium line: representation, nominal 'T', nominal 'π' and end condenser methods. Ferranti effect.	10
Unit-III	**Extra High Voltage Transmission** Extra High Voltage AC (EHVAC) transmission line**:** Necessity, high voltage substation components such as transformers and other switchgears, advantages, limitations and applications and lines in India. High Voltage DC (HVDC) Transmission Line**:** Necessity, components, advantages, limitations and applications. Layout of mono polar, bi-Polar and homo-polar transmission lines in India. Features of EHVAC and HVDC transmission line. Flexible AC Transmission line: Features, & types of FACTS controller. New trends in (FACTS) wireless transmission of electrical power.	06

Unit-IV	**A.C Distribution System** AC distribution and DC distribution: Component's classification, requirements of an ideal distribution system, primary and secondary distribution system. Feeder and distributor, factors to be considered in design of feeder and distributor. Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications. Voltage drops, sending end and receiving end voltage. Numerical based on dc distribution.	10
Unit-V	**Components of Transmission and Distribution Line** Overhead Conductors**:** Properties of material, Types of conductors: Copper, Aluminum, ACSR, Solid, Stranded & bundled conductors and its properties with tradenames, Line supports Requirements, types of line structures and their specifications, methods of erection. Line Insulators**:** Properties of insulating material, selection of material, types of insulators and their applications, causes of insulator failure, derivation of equation of string efficiency for string of three suspension insulator, method so fim proving string efficiency. Introduction to SAG and Spacing between Conductors. Calculation of Span length & sag Calculation Corona – corona formation, advantages & disadvantages, factors affecting corona, Underground Cables**:** Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing	12
Unit -VI	Distribution Sub-Station: Classification of **of indoor & outdoor sub-stations (33/11kv & 11kv/440v).** Functions of their components. Site selection, advantages of distribution substation, disadvantages of distribution substation and its applications.	**04**
	Total	48

References:

1. Utilization of Electric Power & Electric Traction, byG.C. Garg, Khanna Book Publishing Co., New Delhi(ISBN:978- 93-86173-355)
2. Principles of Power System, by V.K. Mehta, S. Chand and Co. New Delhi, ISBN:9788121924962
3. A Course in Electrical Power, by Soni; Gupta; Bhatnagar, Dhanpat Rai and Sons New Delhi, ISBN:9788177000207
4. A Course in Power Systems, byJ.B. Gupta.,S.K.Katariaandsons,NewDelhi,ISBN:9788188458523
5. A.K., A Textbook of Electrical Technology Vol. III, by B.L. The raja S. Chand and Co. New Delhi, ISBN: 9788121924900
6. A Course in Electrical Power, by S.L. Uppal S.K. Khanna Publisher New Delhi, ISBN:9788174092380
7. Electrical Power Transmission and Distribution, by S. Satyanarayana S. pearsons education,NewDelhi,ISBN:9788131707913

8. Ned Mohan, Electrical Power System: A First Course, Wiley India Pvt. Ltd. New Delhi, ISBN:9788126541959
9. Gupta, B.R., Power System Analysis and Design, Chand and Co. New Delhi, ISBN:9788121922388
10. Electrical Power Distribution System, by V Kam raju, T a t a McGraw-Hill, New Delhi, ISBN:9780070151413
11. Piyush Goyal , Electric Power Transmission and Distribution ,Foundation Publishing House.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented Cos associated with the above-mentioned competency:

a) Interpret the normal operation of the electric transmission and distribution systems.
b) Maintain the functioning of the medium and high voltage transmission system.
c) Interpret the para meters of the extra high voltage transmission system.
d) Maintain the functioning of the low voltage AC distribution system.
e) Maintain the components of the transmission and distribution lines.

INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Theory						Credits
2020403	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experience.

- To expose the concepts of energy conversion theory between electrical and mechanical systems by introducing electromechanical energy conversion principles.
- To impart knowledge on construction principle of operation and performance of synchronous motor as well alternator.
- To expose the concepts of single and three phase induction motor and its industrial applications.
- Maintain Induction, Synchronous and FHP Machines used in different applications.

CONTENTS: THEORY

	Name of the Topic	Hrs./Unit
Unit-01	**Three Phase Induction Motor** Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip. Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slip ring induction motor. Rotor quantities: frequency, induced emf, power factor at starting and running condition. Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with Relations among them. Induction motor as a generalized transformer with phasor diagram. Four quadrant operation, Power flow diagram Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters. Speed control methods: stator voltage, pole changing, rotor resistance and VVVF. Motors selection for different applications as per the load torque-speed requirements. Maintenance of three phase induction motors	16
Unit-02	**Single phase induction motors** Double field revolving theory, principle of making these motors self-start. Construction and working: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor. Torque-speed characteristics for all of the above motors. Motor selection for different applications as per the load torque-speed requirements. Maintenance of single-phase induction motors	08

Unit-03	**Three phase Alternators** Principle of working, moving and stationary armatures. Constructional details: parts and their functions, rotor constructions. Windings: Single and Double layer. E.M. F. equation of an Alternator with numerical by considering short pitch factor and distribution factor. Alternator loading: Factors affecting the terminal voltage of alternator; Armature resistance and leakage reactance drops. Armature reaction at various power factors and synchronous impedance. Voltage regulation: direct loading and synchronous impedance methods. Maintenance of alternators	10

Unit-04	**Synchronous motors** Principle of working /operation, significance of load angle. Torques: starting torque, running torque, pull in torque, pull out torque. Synchronous motor on load with constant excitation(numerical), effect of excitation at constant load (numerical). V-Curves and Inverted V-Curves. Hunting and Phase swinging. Methods of Starting of Synchronous Motor. Losses in synchronous motors and efficiency (no numerical). Applications areas	08
Unit-05	**Fractional horse power (FHP) Motors** Construction and working: Synchronous Reluctance Motor, Switched Reluctance Motor, BLDC, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors. Torque speed characteristics of above motors. Applications of above motors	06
	Total	**48**

References:

1. Electric Machines, by P.S. Bimbhra, Khanna Book Publishing Co., New Delhi(ISBN:978-93-86173-294)
2. Basic Electrical Engineering, by V. N. and Mittal,Arvind., McGraw Hill Education New Delhi, ISBN :9780070593572
3. Electrical Machines, by Kothari and Nagrath, McGraw Hill Education. New Delhi, ISBN: 9780070699670
4. Electrical Machines, by S.K. Bhattacharya, McGraw Hill Education, New Delhi, ISBN:9789332902855
5. Electrical Technology Vol-II (AC and DC machines), by , B.L The raja S. Chand and Co. Ltd. New Delhi, ISBN: 9788121924375
6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN:9788174091529
7. Janardan an E.G, Special Electrical Machines, Prentice Hall India, New Delhi ISBN:9788120348806

8. Hughes E., Electrical Technology, ELBS
9. Cotton H., Electrical Technology, ELBS
10. S K Agarwal , Induction, Synchronous and Special Electrical Machines , Foundation Publishing House
11. Vikas Kumar , Electrical Engineering , Foundation Publishing House.

Course outcomes:

The theory, practicalexperiencesandrelevantsoftskillsassociatedwiththiscourseare to be taught and implemented, so that the student demonstrates the following industry-oriented Cos associated with the above-mentioned competency:

a) Maintain three phase in duction motor used in different applications.
b) Maintain single-phase induction motor used in different applications.
c) Maintain three phase alternators used in different applications.
d) Maintain synchronous motors used in different applications.
e) Maintain FHP motors used in different applications

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SOLAR POWER TECHNOLOGIES
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Theory						Credits
2020404	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To develop a comprehensive technological understanding in solar PV system components
- To provide in-depth understanding of design parameters to help design and simulate the performance of a solar PV power plant
- To pertain knowledge about planning, project implementation and operation of solar PV power generation.
- Maintain the efficiency and operation of various types of solar power technologies

CONTENTS: THEORY

Chapter	Name of the Topic	Hrs.
Unit-01	**Solar Energy** • Solar Map of India: Global solar power radiation • Different types of Solar water heaters: Construction, working, specifications and installation. • Solar Heating systems, solar drying and different types of solar cookers solar lighting. • Preventive maintenance of all of the above.	8
Unit-02	**Concentrated Solar Power (CSP)** • Concentrated Solar Power (CSP) plants or solar thermal electric systems • Parabolic Trough: Construction, working and specifications • Parabolic Dish: Construction, working and specifications • Power Tower, Fresnel Reflectors: Construction, working and specifications Solar Sterling engines • Preventive maintenance of all of the above	12
Unit-03	**Solar PV Systems** • Solar PV cell: Types construction, working, typical specifications of solar cells • Solar PV working principle: Series and parallel connections of solar modules Solar Photovoltaic (PV)system: components layout and working. • Solar modules, arrays and their standard specifications Roof top and street light • Solar PV systems and typical specifications • Maintenance of these systems	10
Unit-04	**Solar PV Electronics** • Solar Charge controllers: working and specifications, • Switch gear and cables Batteries: Different types for solar PV systems, • Maintenance and specifications • Solar Inverters: working and specifications • Signal conditioning systems: working and specifications • Solar Power tracking: construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT) • Maintenance of these systems.	10

Unit-05	**Solar PV Off-grid and Grid Tied Systems** • Solar off grid systems: layout and specifications • Solar Grid tied (on grid) systems: Working principle of grid-tied dc-ac inverter, • Grid synchronization and active power export net metering: main features and working • Solar wind Hybrid systems: Layout and specifications.	08
	Total	48

References:

1. Solar Photovoltaic Technology and Systems-A Manual For Technicians, Trainers and Engineers, BY Solanki, Chetan Singh, PHI Learning, New Delhi, ISBN: 9788120347113
2. Renewable Energy Sources and Emerging Technologies, by D.P Kothari, PHI
3. Renewable Energy Systems, by David M.Buchla, Thomas E. Kissell, Thomas L. Floyd,-Pearson Education New Delhi ,ISBN:9789332586826
4. Rachel, Sthuthi, Earnest, Joshua;-Wind Power Technologies, PHIL earning
5. Energy Technology, by O.P. Gupta, Khanna Publishing House, ISBN:978-93-86173-683
6. Solar Power Technologies , R.S. Swaminathan , FPH

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented CO associated with the above mentioned competency:

a) Maintain the solar non-electric equipment.

b) Maintain CSP plants

c) Maintain solar PV systems.

d) Maintain solar PV electronics and MPPT systems

e) Maintain off-gridandon-grid solar power plants.

INDUSTRIAL DRIVES
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Theory						Credits
2020405	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To expose students to the operating principal application and control of power conversion systems employing electric drive to cater to industrial needs.
- To familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications.
- To provide strong foundation to asses performance of different industrial drives considering issues such as, energy efficiency, power quality, economic justification, environmental issues, and practical viabilities.

CONTENTS: THEORY

Chapter	Name of the Topic	Hrs.
Unit-01	**Electric Drives** Need of Electric Drives, Functional Block diagrams of an electric drives DC Motors, Motor Rating Series, Shunt and compound DC motors. Universal motor Permanent magnet motor, DC servo motor, Moving coil motor, Torque motor, Starting and Braking of DC Motors, Brushless DC Motors for servo applications. Maintenance procedure	10
Unit-02	**AC Motors** Single phase AC Motors Resistance split phase motors, Capacitor run motors, Capacitor start motors, Shaded pole motors Three phase Induction Motors Squirrel cage Induction motor, Slip ring Induction Motor Starting methods of Induction Motor Braking methods of Induction, Motor Determination of Motor Rating Maintenance procedure.	12
Unit-03	**DC Drives** Single phase SCR Drives, Half wave converter :Full wave converter, Semi converter & Dual converter Three Phase SCR Drives: Half wave converter, Full wave converter, Semi converter Dual converter Reversible SCR Drives. Speed control methods of DC series Motor Chopper Controlled DC Drives Solar and battery powered vehicles Maintenance procedure.	10
Unit-04	**AC Drives** Starting and Braking of Induction motors Stator voltage control Variable Frequency Control, Voltage Source Inverter Control, Current Source Inverter Control, Rotor Resistance Control, Slip Power Recovery scheme. Solar powered pump drives Maintenance procedure for AC drives Sequences of stages & drives required in each stage for following applications: Textile mills Steel rolling mills Paper mills Sugar mills	10

Unit-05	**Advanced Techniques of Motor Control** Microcontroller/Microprocessor based control for drives Phase locked loop control of DC motor. AC/DC motor drive using Microcomputer control AC / DC motor drive using Microcontroller control. Synchronous Motor drives Ratings & specifications of stepper motor Stepper motor drives employing microcontroller (No programming).	06
	Total	48

References

1. Fundamentals of Electrical Engineering, by Saxena,S. BLal, K. Dasgupta, Cambridge university press pvt. Ltd., New Delhi, ISBN: 9781107464353
2. A Text Book of Electrical Technology Vol-II, by B.L. Theraja,A.K Theraja, S.Chandand Co. Ramnagar, New Delhi, ISBN:9788121924405
3. Basic Electrical Engineering, by V.N. Mittle, Arvind Mittle, McGraw Hill Education ,Noida ,ISBN: 9780070593572
4. Power Electronics, by P.C. Sen Mcgraw Hill Publishing Company Limited, New Delhi.ISBN:9780074624005
5. Dubey Gopal K.,Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi.ISBN:9788173194283
6. Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, Mcgraw-Hill Publishing Company Limited, NewDelhi.ISBN:9780070701991
7. Agrawal , Jai P., Power Electronic Systems Theory and Design, Pearson Education, Inc. ISBN 9788177588859.
8. Design and Testing of Electrical Machines, Deshpande M.V., PHI Publication,ISBN:9788120336452
9. A first course on Electrical Drives by S.K.,Pillai,,WileyEasternLtd.NewDelhi,ISBN:13:978-0470213995
10. Industrial Drives , Rajesh Thakral , FPH

Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented Cos associated with the above-mentioned competency:

- Select relevant DC motor for various electric drive applications.
- Select relevant AC motor for various electric drive applications.
- Maintain the operation of DC Drives.
- Maintain the operation of AC Drives.
- Maintain the operation of microprocessor/micro controlled electric motors.

POWER ELECTRONICS LABORATORY
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Practical						Credits
2020406	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P	ESE	:	50	
	—	—	02	Internal	:	15	
	—	—	—	External	:	35	

CONTENTS: PRACTICAL

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the proper functioning of power electronic devices.
- To understand and acquire knowledge about various power semiconductor devices.
- Maintain the proper functioning of power electronic devices
- To analyze and design different power electronics circuits

Practical's:

1. Test the proper functioning of power transistor.
2. Test the proper functioning of IGBT.
3. Test the proper functioning of DIAC to determine the break over voltage.
4. Determine the latching current and holding current using V-I characteristics of SCR.
5. Test the variation of R, C in R and R C triggering circuits on firing angle of SCR.
6. Test the effect of variation of R, C in UJT triggering technique.
7. Perform the operation of Class–A, B, C, turn off circuits.
8. Perform the operation of Class–D,E, F turn off circuits.
9. Use CRO to observe the output waveform of half wave-controlled rectifier with resistive load and determine the load voltage.
10. Draw the output wave form of Full wave controlled rectifier with R load, RL load, free wheeling diode and determine the load voltage.
11. Determine the firing angle using DIAC and TRIAC phase-controlled circuit on output power under different loads such as lamp, motor or heater
12. Simulate above firing angle control on SCIL AB software
13. Test the performance of given SMPS, UPS.
14. Troubleshoot the Burglar's alarm, Emergency light system, Speed control system, Temperature control system.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

a) Select power electronic devices for specific applications.

b) Maintain the performance of Thyristors.

c) Trouble shoot turn-on and turn-off circuits of Thyristors.

d) Maintain the operation of phase-controlled rectifiers.

e) Maintain the industrial control circuits.

INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES LABORATORY

(ELECTRICAL ENGINEERING GROUP)

Subject Code	Practical						Credits
2020407	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P	ESE	:	50	
	—	—	02	Internal	:	15	
	—	—	—	External	:	35	

CONTENTS: PRACTICAL

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To expose the concepts of energy conversion theory between electrical and mechanical systems by introducing electromechanical energy conversion principles.
- To impart knowledge on construction principle of operation and performance of synchronous motor as well alternator.
- To expose the concepts of single and three phase induction motor and its industrial applications.
- Maintain Induction, Synchronous and FHPM a chines used in different applications.
- Maintain Induction, Synchronous and FHPM a chines used in different applications.

Practical's:

1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2. Connect and run the three-phases squirrel cage induction motors (in both directions) using the DOL star- delta, auto-transformer starters(any two)
3. Perform the direct load test on the three-phase squirrel cage induction motor and plot the

i) Efficiency versus output, ii) power factor versus output, iii) power factor versus motor current and iv) torque – slip/speed characteristics.

4. Conduct the No-load and Blocked-rotor test son given3-phase squirrel cage induction motor and determine the equivalent circuit parameters.
5. Conduct the No-load and Blocked-rotor test son given3-phase squirrel cage induction motor and plot the Circle diagram.
6. Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: i) auto-transformer, ii) VVVF.
7. Measure the open circuit voltage ratio of the three-phase slip ring induction motor.
8. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.

9. Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency.
10. Determine the regulation and efficiency of the given three phase alternators from OC and SC
    tests (Synchronous impedance method)
11. Conduct the test on load or no load top lot the ‘V’ curves and
    inverted ‘V’ curves

    (atno -load) of 3 phase synchronous motor.
12. Dismantling and reassembling of single-phase motors used for ceiling fans, universal motor for mixer.
13. Control the speed and reverse the direction of stepper motor
14. Control the speed and reverse the direction of the AC servomotor
15. Control the speed and reverse the direction of the DC servomotor

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

a) Maintain three phase induction motor used in different applications.
b) Maintain single phase induction motor used in different applications.
c) Maintain three phase alternators used in different applications.
d) Maintain synchronous motors used in different applications.
e) Maintain FHP motors used in different applications.

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INDUSTRIAL DRIVES LABORATORY
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Term Work						Credits
2020408	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P	Internal	:	15	
	—	—	02	External	:	35	

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To expose students to the operation, application and control of power conversion systems employing electric drive to cater to industrial needs.
- To familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications.
- To provide strong foundation to assess performance of different industrial drives considering issues such as, energy efficiency, power quality, economic justification, environmental issues, and practical viabilities.

Practical's:

1. Dismantle the given DC motor and identify its different parts
2. Dismantle the given AC motor and identify its different parts
3. Control the speed of DC Motor using armature voltage control method
4. Control the speed of DC Motor using field current control method
5. Measure the output voltage of chopper for resistive load by varying the frequency and /or duty cycle of chopper.
6. Control the speed of three phase squirrel cage induction motor using stator voltage control method.
7. Effect on speed of given D.C. series motor by varying armature voltage using stepdown chopper.
8. Observe the effect on speed of the given D.C. separately excited motor by varying voltage using step down chopper.
9. Control the speed of the given separately excited motor by changing the firing angle of SCR using single phase semi converter and measure the speed.
10. Control the speed of the given separately exited motor by changing the firing angle of SCR using single phase full converter and measure the speed
11. Control the speed of the given three phase induction motor by using constant V / f method and plot the graph between speed and frequency.
12. Control the speed of the given three phase induction motor by varying frequency and plot the graph between speed and frequency
13. Control the speed of the given synchronous motor drives using microcontroller.
14. Demonstrate High power SCR / power device and Heat sink and write their specifications and rating.
15. Control the speed of single phase capacitor split phase induction motor

using DIAC–TRIAC circuit.

16. Control the speed of DC motor drives using microcontroller.
17. Identify different parts and assemble the given DC motor.
18. Identify different parts and assemble the given AC motor.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

a) Select relevant DC motor for various electric drive applications.
b) Select relevant AC motor for various electric drive applications.
c) Maintain Operation of DC Drives.
d) Maintain Operation of AC Drives.
e) Maintain the Operation microprocessor/micro controlled electric motors.

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MATLAB

Subject Code	Term Work						Credits
2020409	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P	Internal	:	07	
	—	—	02	External	:	18	

Course Content :

1. To find the Frequency response of capacitive Transducer.
2. To find the Loading effect and Frequency response of Piezo-electric effect.
3. To find the impulse response of Piezo-electric Crystel.
4. To Plot the basic magneto-resistive characteristics’
5. To find the unknown resistance using straingauge.
6. To find the displacement and pressure using LVDT and Bellous.
7. To find the low Pressure with Pirani vacuum gauge
8. To generate the sine wave using MAT LAB.
9. To generate the impulse signal using MAT LAB.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION (TW)
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Term Work						Credits
2020410	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P	Internal	:	07	
	—	—	02	External	:	18	

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To introduce the students to the general structure of the network for transferring power from generating stations to the consumers.
- To expose the students to the different electrical & mechanical aspects of the power network along with its environmental and safety constraints
- Maintain the proper functioning of the electrical transmission and distribution systems.

Course contents:

Laboratory work is not applicable for this course.

Following are the suggested student related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various out comes in this course : Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect / record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a report based on transmission line networking Maharashtra.

b. Collect the information on components of transmission line.

c. Evaluate transmission line performance para meters of a given line.

d. Library/Internet survey of electrical high voltage line and HVDC lines.

e. Visit to 33/11KVand11KV/400VDistribution Substation and write a report

Also one micro-project can be assigned to the student. A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a model showing:
   i. Single line diagram of electric supply system.
   ii. Single line diagram of a given distribution system.
   iii. Short line and medium transmission line.
   iv. Write are port on the same by giving the details of lines in Maharashtra State.

b. Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.

c. Prepare a power point presentation:
   i. Extra High Voltage AC Transmission line.
   ii. High Voltage DC Transmission line.
   iii. Flexible AC Transmission line.
   iv. New trends in wireless transmission of electrical power.

d. Collect information on:

i. A.C Distribution System adjacent to your institute.

ii. Draw a layout diagram of 11KV/400Vsubstation in your campus/adjacent substation.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented CO associated with the above mentioned competency:

a) Interpret the normal operation of the electric transmission and distribution systems.

b) Maintain the functioning of the medium and high voltage transmission system.

c) Interpret the parameter soft he extra high voltage transmission system.

d) Maintain the functioning of the low voltage AC distribution system.

e) Maintain the components of the transmission and distribution lines.

SOLAR POWER TECHNOLOGIES (TW)
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Term Work						Credits
2020411	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P	Internal	:	07	
	—	—	02	External	:	18	

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain the efficient operation of various types of solar power technologies

Practicals:

1. Dismantle solar power heaters
2. Assemble solar power heaters
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Troubleshoot a CSP plant
6. Assemble the solar PV system.
7. Dismantle the solar PV system
8. Troubleshoot a solar PV system
9. Troubleshoot a solar PV panels and arrays
10. Troubleshoot solar inverters
11. Troubleshoot solar signal conditioners
12. Troubleshoot solar PV MPPT systems
13. Troubleshoot solar off-grid systems
14. Trouble shoot solar net metering systems
15. Troubleshoot solar-wind hybrid systems.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

a) Maintain the solar non-electric equipment.
b) Maintain CSP plants
c) Maintain solar PV systems.
d) Maintain solar PV electronics and MPPT systems
e) Maintain off-grid and on-grid solar power plants.

AUTOCAD IN ELECTRICAL ENGINEERING TERMWORK
(ELECTRICAL ENGINEERING GROUP)

Subject Code	Term Work						Credits
2020412	No. of Periods Per Week			Full Marks	:	25	02
	L	T	P	Internal	:	07	
	—	—	04	External	:	18	

Course objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Basics of Auto CAD
- Getting comfortable with the Auto CAD Environment
- Electrical drawings and diagrams IEC Standards & Abbreviations – IS
- Electrical, power and lighting system plans
- Design and drawings of Lighting System
- Design and drawings of Residential electrical plan
- Design and drawings of Commercial electrical plan
- Design and drawings of Power System
- Design and drawings of Power Distribution System
- Circuit panels and Boards
- Electrical schematic drawing
- Electrical panel schedules
- Electrical one-line diagrams
- Layouts for lighting showing lighting fixture, emergency lighting etc.

SUMMERER TRAINING / INDUSTRAIL VISITS (TW)
(ELECTRICAL ENGINEERING)

Subject Code	Term Work						Credits
2020413	No. of Periods Per Week			Full Marks	:	25	02
	L	T	P	Internal	:	07	
	—	—	04	External	:	18	

Industrial Visits

Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form a part of the term work.(**ANY THREE OF THEM**)

The industrial visits may be arranged in the following areas / industries :

1) Visit to Transformer Repair Workshop
2) Visit to Electrical Machine Manufacturing Unit.
3) Visit to Load Dispatch Center
4) Visit to Multi Storied Building.
5) Visit to Industry of Power Electronics Devices
6) Visit to Loco Shade.
7) Visit to L & T LT Switchgear Laboratory
8) Visit to Railway Station to study operation of Signaling system.
9) Visit to Large Industry to study Protection Schemes.
10) Any Industry having Automation for manufacturing Processes.