DIPLOMA WING

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA , BHOPAL

SCHEME OF STUDIES & EXAMINATIONS (IMPLEMENTED FROM SESSION : JULY 2023)

SCHEME	NAME OF BRANCH	BRANCH CODE	SEMESTER
OCBC JULY2022/ 2023	ELECTRICAL ENGINEERING	E01	FOURTH (IV)

S.N.	PAPER CODE	SUBJECT CODE	SUBJECT NAME	THEORY COMPONENT								PRACTICAL COMPONENT					TOTAL CREDITS	TOTAL MARKS
				HRS PER WEEK	CREDITS	TERM WORK			TOTAL	THEORY PAPER		HRS PER WEEK	CREDITS	LAB WORK	PRACTICAL EXAM/VIVA			
						QUIZ/ASSIGNMENT	MID TERM TEST*			MARKS	DURATION				MARKS	DURATION		
							I	II										
1	7436	401	FUNDAMEMTALS OF POWER ET.	4	4	10	10	10	30	70	03 Hrs.	2	1	20	30	03 Hrs.	5	150
2	7437	402	ELECTRIC PW. TRANS. & DISTRIBU.	4	4	10	10	10	30	70	03 Hrs.	2	1	20	30	03 Hrs.	5	150
3	7438	403	IND.SYNCH. & SPL. ELECT. M/C	3	3	10	10	10	30	70	03 Hrs.	4	2	20	30	03 Hrs.	5	150
4	7439	411	INDUSTRIAL DRIVES OR	3	3	10	10	10	30	70	03 Hrs.	2	1	20	30	03 Hrs.	4	150
	7440	412	IND. AUTOMATION & CONTROL															
5	7441	421	ELE.TESTING & COMMISIONING OR	3	3	10	10	10	30	70	03 Hrs.	2	1	20	30	03 Hrs.	4	150
	7442	422	ELE. ESTIMATING & CONTRACTING															
6			MINOR PROJECT	0	0	0	0	0	0	0	0	4	2	20	30	03 Hrs.	2	50
7			ESSENCE OF INDIAN KNOWLEDGE & TRADITION	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8			LIBERARY /SEMINAR/VISITS etc.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
TOTAL				19	17				150	350		17	8	120	180		25	800

NOTE - (1)* Two Best,out of Three Mid Term Tests (Progressive Tests) Marks should be entered here.

GRAND TOTAL OF CREDITS	GRAND TOTAL OF MARKS
25	800

DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER IV

COURSE TITLE	:	FUNDAMENTALS OF POWER ELECTRONICS
PAPER CODE	:	7436
SUBJECT CODE	:	401
TREORY CREDITS	:	04
PRACTICAL CREDITS	:	01

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.

Course contents:

Unit – I Power Electronic Devices

Power electronic devices

Power transistor: construction, working principle, V-I characteristics and uses.

IGBT: Construction, working principle, V-I characteristics and uses.

Concept of single electron transistor (SET) - aspects of Nano- technology.

Unit – II Thyristor Family Devices

SCR: construction, two transistor analogy, types, working and characteristics.

SCR mounting and cooling.

Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC

Thyristor family devices: symbol, construction, operating principle and V-I characteristics.

Protection circuits: over-voltage, over-current, Snubber, Crowbar.

Unit– III Turn-on and Turn-off Methods of Thyristors

SCR Turn-On methods: High Voltage thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering.

Gate trigger circuits – Resistance and Resistance-Capacitance circuits.

SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit.

Pulse transformer and opto-coupler based triggering.

SCR Turn-Off methods: Class A- Series resonant commutation circuit, Class B-Shunt

Resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit, Class D –Auxiliary commutation, Class E- External pulse commutation, Class F- Line or natural commutation.

Unit– IV Phase Controlled Rectifiers

Phase control: firing angle, conduction angle.

Single phase half controlled, full controlled and midpoint controlled rectifier with R, RL

load: Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode.

Different configurations of bridge controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCRs in one arm and diodes in another arm.

Unit– V Industrial Control Circuits

Applications: Burglar's alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCR and; Illumination control / fan speed control TRIAC.

SMPS.

UPS: Offline and Online

SCR based AC and DC circuit breakers.

References:

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

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) Troubleshoot turn-on and turn-off circuits of Thyristors.

d) Maintain phase controlled rectifiers.

e) Maintain industrial control circuits.

FUNDAMENTALS OF POWER ELECTRONICS LAB

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.

Practicals:

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 andholding current using V-I characteristics of SCR.
5. Test the variation of R, C in R and RC triggering circuits onfiring 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 waveform 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 SCILAB 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) Troubleshoot turn-on and turn-off circuits of Thyristors.
d) Maintain phase controlled rectifiers.
e) Maintain industrial control circuits.

DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER IV

COURSE TITLE	:	ELECTRIC POWER TRANSMISSION AND DISTRIBUTION
PAPER CODE	:	7437
SUBJECT CODE	:	402
TREORY CREDITS	:	04
PRACTICAL CREDITS	:	01

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 the electrical transmission and distribution systems.

Course contents:

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 type of voltage, voltage level, length and others

Characteristics of high voltage for power transmission.

Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV.

Method of construction of electric supply distribution systems – 220 V, 400V, 11 kV, 33 kV

Unit – II Transmission Line Parameters and Performance

Line Parameters: Concepts of R, L and C of line parameters and types of lines.

Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor.

Performance of medium line: representation, nominal 'T', nominal 'π' and end condenser methods.

Transposition of conductors and its necessity.

Skin effect and proximity effect.

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. Ferranti and Corona effect.

High Voltage DC (HVDC) Transmission Line**:** Necessity, components, advantages, limitations and applications. Layout of monopolar, bi-Polar and homo-polar transmission lines. Lines in India.

Features of EHVAC and HVDC transmission line.

Flexible AC Transmission line: Features, d types of FACTS controller.

New trends in wireless transmission of electrical power.

Unit– IV A.C Distribution System

AC distribution: Components 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 drop, sending end and receiving end voltage.

Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications.

Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V sub-station, Symbols and functions of their components.

Unit– V Components of Transmission and Distribution Line

Overhead Conductors**:** Properties of material, types of conductor with trade names, significance of sag.

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, methods of improving string efficiency.

Underground Cables**:** Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing.

References:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355)
2. Mehta, V.K., Principles of Power System, S. Chand and Co. New Delhi, ISBN: 9788121924962
3. Soni;Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons New Delhi, ISBN: 9788177000207
4. Gupta,J.B., A Course in Power Systems, S.K. Kataria and sons, New Delhi, ISBN: 9788188458523
5. Theraja, B.L.; Theraja, A.K., A Textbook of Electrical Technology Vol. III, S.Chand and Co. New Delhi, ISBN : 9788121924900
6. Uppal,S.L., A Course in Electrical Power, S.K.Khanna Publisher New Delhi, ISBN : 9788174092380
7. Sivanagaraju S.; Satyanarayana S., Electrical Power Transmission and Distribution, Pearson Education, New Delhi, , 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, S. Chand and Co. New Delhi, ISBN: 9788121922388
10. Kamraju, V., Electrical Power Distribution System, Tata McGraw-Hill, New Delhi, ISBN:9780070151413

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 parameters 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.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION LAB

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 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 outcomes 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 network in Maharashtra.
b. Collect the information on components of transmission line.
c. Evaluate transmission line performance parameters of a given line.
d. Library/Internet survey of electrical high voltage line and HVDC lines.
e. Visit to 33/11 KV and 11KV/400V Distribution 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 a report 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/400 V substation 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 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 parameters 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.

DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER IV

COURSE TITLE	:	INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES
PAPER CODE	:	7438
SUBJECT CODE	:	403
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	02

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 Induction, Synchronous and FHP Machines used in different applications.

Course contents:

Unit – I 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.

Motor selection for different applications as per the load torque-speed requirements.

Maintenance of three phase induction motors

Unit – II 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

Unit– III 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

Unit– IV 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

Unit– V 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.

References:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-294)
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education New Delhi, ISBN :9780070593572
3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi, ISBN:9780070699670
4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN:9789332902855
5. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S.Chand and Co. Ltd., New Delhi, ISBN : 9788121924375
6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN: 9788174091529
7. Janardanan E. G, Special Electrical Machines, Prentice Hall India, New Delhi ISBN: 9788120348806
8. Hughes E., Electrical Technology, ELBS
9. Cotton H., Electrical Technology, ELBS

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.

INDUCTION,SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES LAB

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 Induction, Synchronous and FHP Machines used in different applications.

Practicals:

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 phase 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 tests on given 3-ϕ squirrel cage induction motor and determine the equivalent circuit parameters.
5. Conduct the No-load and Blocked-rotor tests on given 3-ϕ 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 alternator from OC and SC tests (Synchronous impedance method)
11. Conduct the test on load or no load to plot the 'V' curves and inverted 'V' curves (at no-load) of 3-ϕ 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 servo motor
15. Control the speed and reverse the direction of the DC servo 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) 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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DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER IV

COURSE TITLE	:	INDUSTRIAL DRIVES
PAPER CODE	:	7439
SUBJECT CODE	:	411
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	01

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 electric AC and DC Drives.

Course contents:

Unit – I Electric Drives

Need of Electric Drives, Functional Block diagrams of an electric drives.

DC Motors, Motor Rating

a. Series, Shunt and compound DC motors.
b. Universal motor
c. Permanent magnet motor
d. DC servo motor
e. Moving coil motor
f. Torque motor.

Starting and Braking of DC Motors

Brushless DC Motors for servo applications.

Maintenance procedure.

Unit – II AC Motors

Single phase AC Motors

a) Resistance split phase motors
b) Capacitor run motors
c) Capacitor start motors
d) Shaded pole motors

Three phase Induction Motors

a) Squirrel cage Induction motor
b) Slip ring Induction Motor
c) Starting methods of Induction Motor
d) Braking methods of Induction Motor

Determination of Motor Rating

Maintenance procedure.

Unit– III DC Drives

Single phase SCR Drives

a) Half wave converter
b) Full wave converter
c) Semi converter
d) Dual converter

Three Phase SCR Drives

a) Half wave converter
b) Full wave converter
c) Semi converter
d) Dual converter

Reversible SCR Drives.

Speed control methods of DC series Motor

Chopper Controlled DC Drives

Solar and battery powered vehicles

Maintenance procedure.

Unit– IV 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

Solar powered pump drives

Maintenance procedure for AC drives

Sequences of stages & drives required in each stage for following applications:

a) Textile mills
b) Steel rolling mills
c) Paper mills
d) Sugar mills

Unit– V 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)

References:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-294)
2. Saxena, S.B Lal ;Dasgupta, K., Fundamentals of Electrical Engineering, Cambridge university press pvt. Ltd., New Delhi, ISBN: 9781107464353
3. Theraja, B. L. ;Theraja, A. K., A Text Book of Electrical Technology Vol-II, S. Chand and Co. Ramnagar, New Delhi, ISBN :9788121924405
4. Mittle, V.N. ;Mittle, Arvind, Basic ElectricalEngineering, McGraw Hill Education, Noida, ISBN: 9780070593572
5. Sen P.C., Power Electronics, Mcgraw-Hill Publishing CompanyLimited, New Delhi. ISBN:9780074624005
6. Dubey Gopal K., Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi.ISBN :9788173194283
7. Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, Mcgraw-Hill Publishing CompanyLimited, New Delhi.ISBN:9780070701991
8. Agrawal , Jai P., Power Electronic Systems Theory and Design, Pearson Education, Inc. ISBN 9788177588859.
9. Deshpande M.V., Design and Testing of Electrical Machines, PHI Publication, ISBN: 9788120336452
10. Pillai, S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, ISBN :13: 978-0470213995

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 DC Drives.

d) Maintain AC Drives.

e) Maintain microprocessor/micro controlled electric motors.

INDUSTRIAL DRIVES LAB

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 electric AC and DC Drives.

Practicals:

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 step down 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 DC Drives.

d) Maintain AC Drives.

e) Maintain microprocessor/micro controlled electric motors.

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DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER IV

COURSE TITLE	:	INDUSTRIAL AUTOMATION AND CONTROL
PAPER CODE	:	7440
SUBJECT CODE	:	412
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	01

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 Industrial Automation Systems.

Course contents:

Unit – I Introduction to Industrial Automation

Automation: Need and benefits.

Types of automation system: Fixed, Programmable, Flexible

Different systems used for Industrial automation: PLC, HMI, SCADA, DCS, Drives.

Evolution of PLC.

Unit – II PLC Fundamentals

Building blocks of PLC**:** CPU, Memory organization, Input- output modules (discrete and analog), Specialty I/O Modules, Power supply

Fixed and Modular PLC and their types, Redundancy in PLC module

I/O module selection criteria

Interfacing different I/O devices with appropriate I/O modules

Unit– III PLC Programming and Applications

PLC I/O addressing

PLC programming Instructions**:** Relay type instructions, Timer instructions: On delay, off delay, retentive, Counter instructions: Up, Down, High speed, Logical instructions, Comparison Instructions, Data handling Instructions, Arithmetic instructions.

PLC programming language**:** Functional Block Diagram (FBD), Instruction List. Structured text, Sequential Function Chart (SFC), Ladder Programming.

Simple Programming examples using ladder logic**:** Language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions.

PLC Based Applications: Motor sequence control, Traffic light control, Elevator control, Tank Level control, Conveyor system, Stepper motor control, Reactor Control Gate trigger circuits – Resistance and Resistance-Capacitance circuits.

Unit– IV Electric Drives and special machines

Electric drives: Types, functions, characteristics, four quadrant operation.

DC and AC drive controls: V/F control, Parameters, direct torque control.

Drives: Specifications, Applications- Speed control of AC motor /DC Motor.

Unit– V Supervisory Control and Data Acquisition System (SCADA)

Introduction to SCADA: Typical SCADA architecture/block diagram, Benefits of SCADA

Various editors of SCADA

Interfacing SCADA system with PLC: Typical connection diagram, Object Linking & embedding for Process Control(OPC) architecture, Steps in Creating SCADA Screen for simple object, Steps for Linking SCADA object (defining Tags and Items) with PLC ladder program using OPC.

Applications of SCADA: Traffic light control, water distribution, pipeline control.

References:

1. Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 : 9781401884260
2. Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN : 9788174092281
3. Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, New Delhi, 2010, ISBN: 9780071067386
4. Hackworth, John; Hackworth, Federic, Programmable Logic Controllers, PHI Learning, New Delhi, 2003, ISBN : 9780130607188
5. Stenerson Jon, Industrial automation and Process control, PHI Learning, New Delhi, 2003, ISBN : 9780130618900
6. Mitra, Madhuchandra; Sengupta, Samarjit, Programmable Logic Controllers and Industrial Automation - An introduction, Penram International Publication, 2015, ISBN: 9788187972174
7. Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 978-1936007097
8. Bailey David ; Wright Edwin, Practical SCADA for industry, Newnes (an imprint of Elsevier), UK 2003, ISBN:0750658053

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) Identify different types of automation systems.

b) Interface I/O devices with the PLC modules.

c) Develop PLC ladder programs for various applications.

d) Select the suitable motor drives for different applications

e) Prepare simple SCADA applications.

INDUSTRIAL AUTOMATION AND CONTROL LAB

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 Industrial Automation Systems.

Practicals:

1. Identify various automation systems available in different appliances/ devices/ machines in day to day use.
2. Identify various parts of the given PLC and front panel status indicators.
3. Use PLC to test the START STOP logic using two inputs and one output.
4. Develop/Execute a ladder program for the given application using following: - timer, counter, comparison, logical, arithmetic instructions.
5. Use PLC to control the following devices like lamp, motor, push button switches, proximity sensor
6. Measure the temperature of the given liquid using RTD or Thermocouple and PLC.
7. Develop/test ladder program to blink the LED/lamp.
8. Develop / test the Ladder program for sequential control application of lamps/ DC motors.
9. Develop ladder program for Traffic light control system.
10. Develop and test ladder program for pulse counting using limit switch /Proximity sensor.
11. Develop /test ladder program for Automated car parking system.
12. Develop / test ladder program for Automated elevator control.
13. Develop / test ladder program for rotating stepper motor in forward and reverse direction at constant speed.
14. Develop /test ladder program for tank water level control.
15. Develop / test ladder program for control of speed of stepper motor with suitable drivers.
16. Identify various front panel controls of VFD (smart drive).
17. Control speed of AC/DC motor using VFD. (VFD-Variable Frequency Drive)
18. Use various functions of SCADA simulation editors to develop simple project.
19. Develop a SCADA mimic diagram for Tank level control.
20. Develop SCADA mimic diagram for Flow control in a given system.
21. Simulate Tank level control using available SCADA 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:

b) Identify different types of automation systems.

c) Interface I/O devices with the PLC modules.

d) Develop PLC ladder programs for various applications.

e) Select the suitable motor drives for different applications.

f) Prepare simple SCADA applications.

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DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER IV

COURSE TITLE	:	ELECTRICAL TESTING AND COMMISIONING
PAPER CODE	:	7441
SUBJECT CODE	:	421
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	01

Course objectives:

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

- Follow standard safety procedures in testing and commissioning of electrical equipment.

Course contents:

Unit – I Electrical Safety and Insulation

Do's and don'ts regarding safety in domestic electrical appliances as well for substation/ power station operators

Electrical safety in industry/power stations/ substations at the time of operation/ control/ maintenance. Fire detection alarm, fire-fighting equipments

Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958

Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation

Reconditioning of insulation,

Insulating oil - properties of insulating oil, causes of deterioration of oil,

testing of transformer oil as per IS 1866-1961

Unit – II Installation and Erection

Concept of foundation for installation of machinery. Requirements of foundation for static and rotating electrical machinery.

Concept of leveling and aligning Procedure for leveling and aligning alignment of direct coupled drive, effects of mis-alignment

Installation of transformer as per I.S.-1886-1967 and procedure of installation of transformer, Requirements of installation of pole mounted transformer

Requirements of installation of rotating electrical machines as per I.S. 900 - 1965

Devices and tools required for loading, unloading, lifting, and carrying heavy equipment and precautions to be taken while handling them.

Unit– III Testing and Commissioning

Concept of testing, Objectives of testing. Roles of I.S.S. in testing of electrical equipment, Types of tests and concepts, Routine tests, type tests, supplementary test, special tests, Methods of testing - Direct/Indirect/Regenerative testing.

Tolerances for the various items for equipment –transformer, induction motor, dc motor, synchronous machines

Commissioning, Tests before Commissioning for transformer, induction motor, alternator

Testing of transformer as per I.S.1886- 1967 and I.S.2026- 1962

Testing of three-phase Induction motor as per I.S.325 - 1970.

Testing of single-phase induction motor as per I.S.990-1965.

Testing of synchronous machines as per ISS

Testing of D.C. machines

Unit– IV Troubleshooting Plans

Internal and external causes for failure / abnormal operation of equipment.

List of mechanical faults, electrical faults and magnetic faults in the electrical equipment remedies, applications

Use of tools like bearing puller filler gauges, dial indicator, spirit level, megger, earth tester, and growler. Common troubles in electrical equipments and machines.

Preparation of trouble shooting charts for D.C. Machines, AC Machines and transformers.

Unit– V Maintenance

Concept of maintenance, types of maintenance, Routine, preventive and breakdown maintenance.

Causes of failure of electrical machines

Preventive maintenance-procedure or developing maintenance schedules for electrical machines.

Factors affecting preventive maintenance schedules, Concept of TPM, Pillars of TPM

Identification of different types of faults developed such as mechanical/ electrical/ magnetic faults

Maintenance schedules of the following as per I.S.S.

a) Distribution transformer as per I.S.1886-1967
b) Single phase and three phase Induction motors as per I.S.900-1965.
c) Batteries

References:

1. Deshpande.M. V. PHI Learning Pvt. Ltd., 2010, Design and Testing of Electrical Machines ISBN No 8120336453, 9788120336452.
2. Rao, B V S Asia Club House, First Reprint, 2011, Operation and Maintenance of Electrical Equipment Vol-I, ISBN No 8185099022
3. Rosenberg. Mc GRAW-HILL, 1st Edition, May 2003, Maintenance and Repairs, ISBN No 9780071396035
4. Sharotri, S.K. Glencoe/ Mcgraw- Hill; 2ndEdition , June 1969; Preventive Maintenance of Electrical Apparatus, ISBN No 10: 007030839X 13: 978-0070308398

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) Follow safety procedures with respect to earthing and insulation of electrical equipment
b) Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers
c) Test and commission electrical equipment in accordance with IS codes
d) Make plans for troubleshooting electrical machines.
e) Undertake regular preventive and breakdown maintenance.

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ELECTRICAL TESTING AND COMMISIONING LAB

Course objectives:

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

- Follow standard safety procedures in testing and commissioning of electrical equipment.

Practicals:

1. Determine breakdown strength of transformer oil.
2. Perform insulation resistance test on any one motor/transformer.
3. Prepare trouble shooting charts for electrical machines such as Transformer, D.C. machines, Induction motor, and Synchronous machines
4. Measure impedance voltage and load losses of three-phase transformer.
5. Find regulation and efficiency of single-phase transformer by direct loading and back-to-back connection method and compare the results.
6. Determine efficiency of D.C. machine by Swinburne's test.
7. Determine efficiency of D.C. machine by Hopkinson's test.
8. Perform reduced voltage running up test on three-phase Induction motor as per I.S.325 -1967.
9. Measure no load losses and no load current of a transformer as per IS.
10. Perform no load test on single phase Induction motor for the measurements of no load current, power input, and speed at rated voltage as per I.S.
11. Perform temperature rise test on single-phase transformer.
12. Find efficiency of M.G. set

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) Follow safety procedures with respect to earthing and insulation of electrical equipment

b) Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers

c) Test and commission electrical equipment in accordance with IS codes

d) Make plans for troubleshooting electrical machines

e) Undertake regular preventive and breakdown maintenance.

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DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER IV

COURSE TITLE	:	ELECTRICAL ESTIMATION AND CONTRACTING
PAPER CODE	:	7442
SUBJECT CODE	:	422
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	01

Course objectives:

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

- Design electrical installation with costing for tendering

Course contents:

Unit – I Electric Installation and Safety

Scope and features of National electric code 2011

Types of electrical installation

Fundamental principles for electrical installation

Permit to work, safety instructions and safety practices

Purpose of estimating and costing.

Unit – II Estimation and Costing

Meaning and purpose of- Rough estimate, detailed estimate, supplementary estimate, annual maintenance estimate and revised estimate

Factors to be considered while preparation of detailed estimate and economical execution of work

Contracts- Concepts of contracts, types of contracts, contractor, role of contractor

Tenders and Quotations- Type of tender, tender notice, preparation of tender document, and method of opening of tender

Quotation, quotation format, comparison between tender and quotation

Comparative statement, format comparative statement. Order format, placing of purchasing order.

Principles of execution of works, planning, organizing and completion of work, Billing of work

Unit– III Non-Industrial Installations

Types of Non-industrial installations-- Office buildings, shopping and commercial centre, residential installation, Electric service and supply

Design consideration of electrical installation in commercial buildings.

Design procedure of installation- steps involved in detail, Estimating and costing of unit

Earthing of commercial installation.

Design electrical installation scheme of commercial complex.

Erection, Inspection and testing of installation as per NEC

Unit– IV Industrial Installation

Classification of industrial buildings Classification based on power consumption,

Drawing of wiring diagram and singleline diagram for single phase and three phase

Motors.

Design consideration in industrial installations Design procedure of installation-detailed steps

Design electrical installation scheme of factory/ small industrial unit, Preparation of material schedule and detailed estimation

Installation and estimation of agricultural pump and flourmill

Unit– V Public Lighting Installation

Classification of outdoor installations streetlight/ public lighting installation

Street light pole structures. Selection of equipments, sources used in street light installations.

Cables, recommended types and sizes of cable. Control of street light installation.

Design, estimation and costing of streetlight

Preparation of tenders and abstracts.

Unit– VI Distribution Lines and LT Substation

Introduction to overhead and underground distribution line.

Materials used for distribution line HT and LV

Cables used for distribution line, factors determining selection of LT/ HT power Cables, cable laying and cable termination method according to IS

Design, estimation and costing of HT LT overhead line and underground cabling.

Types of 11 KV Distribution substations their line diagram, Estimation of load, Load factor, diversity factor and determination of rating of distribution.

Transformer. Design, estimation and costing of outdoor and indoor 11 KV substation.

References:

1. Raina, K.B.; Dr. S. K. Bhattacharya New Age International Publisher First, Reprint 2010, Electrical Design Estimating and Costing ISBN: 978-81-224-0363-3
2. Allagappan,, N. S. Ekambarram, Tata Mc-Graw Hill Publishing Co. Ltd, Electrical Estimating and Costing, ISBN 13: 9780074624784
3. Singh, Surjit Ravi Deep Singh, Dhanpat Rai and Sons, Electrical Estimating and Costing, ISBN 13:1234567150995
4. Gupta, J.B. S.K. Katariaand Sons Reprint Edition, A Course in Electrical Installation Estimating and Costing ISBN 10: 935014279113: 978-9350142790.
5. Bureau of Indian Standard. IS: 732-1989, Code of Practice for Electrical Wiring Installation
6. Bureau of Indian Standard. SP-30:2011, National Electrical Code 2011

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) Follow National Electrical Code 2011 in electrical installations.

b) Estimate the electrical installation works

c) Estimate the work of non-industrial electrical installations.

d) Estimate the work of industrial electrical installations.

e) Prepare abstract, tender, quotation of public lighting and other installations.

f) Prepare abstract, tender, quotation of low tension (LT) substations.

ELECTRICAL ESTIMATION AND CONTRACTING LAB

Course objectives:

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

- Design electrical installation with costing for tendering.

Practicals:

1. Prepare a tender notice for purchasing a transformer of 200 KVA for commercial installation.
2. Prepare a quotation for purchasing different electrical material required.
3. Prepare a comparative statement for above material Prepare purchase order for the same.
4. Design drawing, estimating and costing of hall / cinema theater / commercial installation Prepare report and draw sheet.
5. Design electrical installation scheme for any one factory / small industrial unit. Draw detailed wiring diagram. Prepare material schedule and detailed estimate. Prepare report and draw sheet.
6. Estimate with a proposal of the electrical Installation of streetlight scheme for small premises after designing.
7. Estimate with a proposal of the L.T. line installation. Prepare report and draw sheet.
8. Estimate with a proposal of the 500 KVA, 11/0.433 KV outdoor substation and prepare a report

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) Follow National Electrical Code 2011 in electrical installations.
b) Estimate the electrical installation works
c) Estimate the work of non-industrial electrical installations.
d) Estimate the work of industrial electrical installations.
e) Prepare abstract, tender, quotation of public lighting and other installations.
f) Prepare abstract, tender, quotation of low tension (LT) substations.

DIPLOMA WING

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER - IV

COURSE TITLE	:	MINOR PROJECT
PAPER CODE	:	--
SUBJECT CODE	:	--
TREORY CREDITS	:	00
PRACTICAL CREDITS	:	02

MINOR PROJECT –

Evaluation is based on work done, quality of report performance in viva-voce, presentation etc.

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DIPLOMA WING
RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

DIPLOMA IN ELECTRICAL ENGINEERING (E01)

SEMESTER - IV

COURSE TITLE	:	ESSENCE OF INDIAN KNOWLEDGE & TRADITION
PAPER CODE	:	--
COURSE CODE	:	--
TREORY CREDITS	:	00
PRACTICAL CREDITS	:	00

Course Content:

Basic Structure of Indian Knowledge System:

(i) वेद, (ii) उन्नवेद (आयवेद, धनुवेद गन्धवेद स्थान्नत्य आदद) (iii) वेदांग (शिक्षा कल्न ननरूत व्याकरण ज्योनतष छांद),

(iv) उन्नाइग (धर्म र्ीरांसा, न्नुराण, तकमिस्त्र)

- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

SUGGESTED TEXT/REFERENCE BOOKS:

S. No.	Title of Book	Author	Publication
1.	Cultural Heritage of India-Course Material	V. Sivaramakrishna	Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2.	Modern Physics and Vedant	Swami Jitatmanand	Bharatiya Vidya Bhavan
3.	The wave of Life	Fritzof Capra	
4.	Tao of Physics	Fritzof Capra	
5.	Tarkasangraha of Annam Bhatta, Inernational	V N Jha	Chinmay Foundation, Velliarnad, Amaku,am
6.	Science of Consciousness Psychotherapy and Yoga Practices	RN Jha	Vidyanidhi Prakasham, Delhi, 2016

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