National Institute of Technology Raipur												
Course of Study and Scheme of Examination							B. Tech. 8th Semester				Branch:Electrical	
S. No.	Subject Code	Subject Name	Periods per Week			TA	Examination Scheme				Total Marks	Credits
							MSE/MTR		ESE/ESVE			
			L	T	P		Theory	Prac.	Theory	Prac.		
1	Open Elective (0XX4)		3	0	0	20	30		50		100	3
2	Open Elective (0XX5)		3	0	0	20	30		50		100	3
3	Project-II		0	0	8	20	30		50		100	4
4	Major Internship*											4(3^+1^^)

***For semester long internship as per clause number 4.E.6 of CBCS B. Tech Ordinance.**

^ - Report submission, end semester presentation and viva

^^ - Mid semester examination (viva/presentation)

Subject Code	Open Elective (0XX4)
EL108301EL	Industrial Drives
EL108302EL	Illumination Engineering
EL108303EL	Energy Audit, Conservation and Management
Subject Code	**Open Elective (0XX5)**
EL108304EL	Medical Signal & Image Processing
EL108305EL	PLC and SCADA
EL108306EL	Mechatronics

Industrial Drives

[8th Semester, Fourth Year]

Course Description Offered by Department	Credits	Status	Code
Electrical	3-0-0, (3)	Open Elective	EL108301EL

[Pre-requisites: Basic Electrical Engineering (EL10I022EL)]

Course Objectives

1. To make the students significance of electrical drives in industry
2. To acquaint the students with the speed and torque control techniques.

Course Content

UNIT 1 Industrial Drives Fundamentals

Introduction, Classification of Industrial Drives, Requirements of Industrial Drives, Dynamics of Electrical Drives; Review of Torque-Speed Characteristics of DC and AC Motors including Motoring and Braking, Basics of Industrial Motor Control.

Unit 2 DC Drives

Phase-Controlled DC Drives and control: Converter fed DC Drives; Control of DC Motor Drives; Torque Speed Characteristics of Converter-fed DC Drives, Chopper Controlled DC Drives (Single and Multi-quadrant Operation), Motoring and Braking operations, Ward Leonard Drive, Brushless DC motor Drives.

Unit 3 AC Drives

Phase-Controlled AC Drives and control: Stator Voltage Control, Voltage Source Inverter (VSI) fed induction motor drive, Current Source Inverter (CSI) fed induction motor drive, Variable voltage variable frequency control of induction motor, Slip speed control of induction motor, Constant Volt/Hz control with slip speed regulation, Slip Power Recovery Scheme, Closed-loop control.

Unit 4 Industrial Application of Electrical Drives

Electric Traction Drives: Requirement of Traction motors, Drives used Steel Mill, Cement Mill, Rolling Mill Drive, Kiln Drive, Textile Industry, Paper Industry, Crane Drives, Sugar Mill, Petrochemical Industry Losses in Electrical Drives, Energy efficient Operation of Drives, Improvement of power factor, Energy Savings with Variable Speed Drives Solar and Battery Powered Drives.

Course Materials

Required Text: Textbooks

1. Gopal K. Dubey, Narosa ,"Fundamentals of Electrical Drives", Second Edition ,2010.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control", Pearson Education India, 1st edition, 2015.
3. Vedam Subrahmanyam, "Electric Drives: Concepts and Applications", McGraw Hill Education, 2nd edition 2017.
4. Theodore Wildi , "Electric Machines Drives and Power Systems", Pearson Education, 6th edition,2013.

Optional Materials: Reference Books

1. Ned Mohan,"Electric Machines and Drives: A First Course", Wiley, 2013.
2. Austin Hughes, "Electric Motors and Drives: Fundamentals, Types and Applications", Newnes (an imprint of Butterworth-Heinemann Ltd), 5th edition, 2019.
3. Juha Pyrhonen, Valeria Hrabovcova, R. Scott Semken, "Electrical Machine Drives Control: An Introduction", Wiley, 1st edition, 2016.

Course Outcomes

1. Appraise the concept and different components of industrial drives and their role in our society.
2. Interpret the operating concept, control and analyze the performance of DC Drive systems.
3. Interpret the operating concept, control and analyze the performance of AC Drive systems.
4. To acquire the knowledge of different methods of speed control and braking of AC and DC drives and its influence on the operation of drives.
5. Infer the practical application, structure, different features, advantages of drives used indifferent industry.

Mapping of the Course Outcome with Program Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3			3	2	2				3
CO2	3	3	3	3	3		2					3
CO3	3	3	3	3	3		2					3
CO4	3	3	3	3	3		2		1	1		3
CO5			3	3		3	3	2	3	1	2	3

Illumination Engineering

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electrical Engineering	3-0-0, (3)	Open Elective (OE)	EL108302EL

[Pre-requisites: Basic Electrical Engineering EL101022EL]

Course Objectives

To make student understand the importance of illumination engineering in energy conservation and to guide them towards acquiring the knowledge regarding the fundamentals and elementary design aspects of artificial lighting.

Course Content

Unit-1 Fundamentals of illumination engineering:

Radiant energy, Nature of light, Plane angle, Solid angle, Relation between plane angle and solid angle, Luminous flux, Luminous intensity, Lumen, Candle power, Brightness or Luminance, Illumination, Uniform diffuse source, Mean horizontal candle power (M.H.C.P.), Mean spherical candle power (M.S.C.P.), Mean hemi-spherical candle power (M.H.S.C.P.), Reduction factor, Lamp efficacy, Specific consumption, Utilization factor, Space-height ratio, Coefficient of utilization, Maintenance factor, Depreciation factor, Waste light factor, Absorption factor, Beam factor, Reflection factor, Glare.

Unit-2 Measurement and analysis of artificial lighting:

Laws of Illumination: inverse square law; cosine law; Lambert's law, Polar curves, Photometry: Photometer bench, Photometer heads, Lummer-bodhun photometer head, Flicker photometer, Integrating sphere, Illumination photometer, Energy radiation and luminous efficiency.

Unit-3 Electric lamps

Incandescent lamp: heat radiation; filament materials; filament dimension measurement; coiled-coil filament; lamp characteristics, Arc lamp: carbon arc lamps; flame arc lamps; magnetic arc lamps, electric discharge lamps: excitation; ionization; lamps characteristics, Hot cathode lamp, Cold cathode lamp, Neon lamp, Sodium vapour lamp, Mercury vapour lamp, Halogen lamps, Fluorescent lamp: phosphor; starters; chokes; stroboscopic effect; its operation on DC, LEDs, LEDs in communication.

Unit-4 Lighting fittings and schemes:

Requirements of good lighting, symmetrical fittings: A type fitting; B type fitting; C type fitting; D type fitting; E type fitting, Asymmetrical fittings, Factory lighting, Flood lighting, Street lighting: diffusion principle; specular reflection principle, Recommended illumination levels for different purposes.

Course Materials

Required Text: Text books

1. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", Revised 3rd Edition, 2012, New Age International Publisher
2. R. K. Rajpur, "Utilization of Electrical Power (including electric Drives and electric Traction)", 1st Edition, Reprint 2012, Laxmi Publications (P) LTD
3. 3. Chakrabarti, Soni, Gupta, Bhatnagar, "Power system Engineering", Dhanpatrai & Co., Second revised edition 2010, Reprint: 2014.

Optional Materials: Reference Books

1. J.B. Gupta, R. Manglik, R. Manglik, "Utilisation of Electrical Energy and Traction", 1st Edition, 2012, S. K. Kataria and Sons
2. Tarlok Singh, "Utilization of Electric Energy", 2nd Edition ,2018, S.K. Kataria & Sons

Course Outcomes

1. Apply an appropriate measurement and analysis technique of artificial lighting for different specific purposes.
2. Investigate on various types of electric bulbs as well as can evaluate their performance in terms of their colour rendering and luminous efficacy.
3. Develop a clear idea on various illumination techniques and hence can design lighting schemes for specific applications.
4. Select as well as apply an appropriate light fitting method for any specific application.

5. Identify, formulate, and figure out the need of research and development activities required for developing efficient artificial illumination.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2	3	2	2	1	3	3	3
CO2	2	3	1	2	2	2	3	1	1	2	3	3
CO3	3	2	3	3	2	3	3	3	3	3	3	3
CO4	2	3	1	1	1	3	1	1	3	2	2	3
CO5	3	3	2	3	3	3	3	3	3	3	1	3

Energy Audit, Conservation and Management

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electrical Engineering	3-0-0, (3)	Open Elective	EL108303EL

[Pre-requisites: Utilization of Electrical Energy(EL104105EL)]

Course Objectives

To know the necessity of conservation of energy, generalize the methods of energy management, illustrate the factors to increase the efficiency of electrical equipment, detect the benefits of carrying out energy audits.

Course Content

Unit 1 Basic Principles of Energy Audit

Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

Unit 2 Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

Unit 3 Energy Efficient Motors

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit.

Unit 4 Power Factor Improvement, Lighting and Energy Instruments

Power factor – methods of improvement, location of capacitors, power factor with nonlinear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

Unit 5 Economic Aspects and Analysis

Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment .

Course Materials

Required Text: Textbooks

1. Energy Audit and Management, Volume-I, IECC Press.
2. Energy Efficiency in Electrical Systems, Volume-II, IECC Press.
3. W.R. Murphy, G. Mckay Butter worth," Energy management", Elsevier/bsp Books Pvt. Ltd., 2003.

Optional Materials: Reference Books

1. Albert Thumann, P.E., C.E.M. William J. Younger, "Handbook of Energy Audits", River Publishers, 9th edition, 2012.
2. Paul o' Callaghan,"Energy management", McGraw-Hill Education, 1992.

Course Outcomes: After the completion of the course the student will be able to :

1. Understand the necessity of conservation of energy.
2. Know about various tests to be carried out for energy audit.
3. Lear about the methods of energy management.
4. Understand about Power Factor Improvement methods, Lighting and Energy Instruments.
5. Know about the Economic Aspects and Analysis.

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	1	1	2	1	2
CO2	3	3	3	3	3	3	3	1	1	2	1	2
CO3	3	3	3	3	3	3	3	1	1	2	1	2
CO4	3	3	3	3	3	3	3	1	1	2	1	2
CO5	3	3	3	3	3	3	3	1	1	2	1	2

Medical Signal and Image Processing

[8th Semester, Fourth Year]

Course Description
Offered by Department
Electrical Engineering

Credits
3-0-0, (3)

Status
Open Elective

Code
EL108304EL

[Pre-requisites: Signal & Systems (EL104104EL)]

Course Objectives: To have an understanding on the application of digital image and signal processing techniques on medical signal and images.

Course Content

Unit-1 Biomedical Signals and Images: Medical Imaging Modalities (ultrasound, X-ray, CT, MRI, PET, and SPECT), MRI, Speech Signals, ECG, Data Acquisition: Sampling in time, aliasing, interpolation, and quantization, Power spectral density, Adaptive filter and algorithms, Current Clinical Problems.

Unit-2 Image Processing Techniques: Components of an image processing system, Digital image representation, Image Enhancement, thresholding and segmentation, Image Compression, Image restoration,

Unit-3 Cardiological Signal Processing: Introductionto electrocardiography, acquisition, lead system, ECG features and their estimation. Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia detection Algorithms, automated ECG analysis. ECG pattern recognition, Heart rate variability analysis, clinical applications.

Unit-4 Neurological Signal Processing: Introduction to brain potential and EEG Signals, its origin, characteristics, frequency division, and evoked potentials. Analysis and detection of spikes and spindles in different frequency bands, Auto Regressive (AR) method for transient detection in case of seizure and sleep stage analysis. Case study: Brain computer interfacing (BCI).

Course Materials
Required Text: Textbooks

1. W. Birkfellner, Applied Medical Image Processing: A Basic Course, CRC Press , Second Edition,2014
2. Rangaraj M. Rangayyan"Biomedical Signal Analysis". IEEE Press, 2001.
3. D.C.Reddy, Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill. 3. Biomedical Digital Signal Processing, Willis J.Tompkins, PHI.

Optional Materials: Reference Books

1. I. Bankman, Handbook of Medical Image Processing and Analysis, Academic Press , Second Edition, 2008
2. AkayM , Biomedical Signal Processing, Academic: Press.
3. Cohen.A, Biomedical Signal Processing -Vol. I Time & Frequency Analysis, CRC Press
4. R C Gonzalez, Wintz Paul, "Digital Image Processing", Addision Wesley, 2ND Edition

Course Outcomes

On successful completion of the course students will be able to:

1. Explain different medical image and signal modalities and their acquisition.
2. Demonstrate an understanding of different techniques in medical image processing.
3. Apply methods to extract relevant information from Cardio logical Signals.
4. Apply methods to extract relevant information from Neurological Signal.

Mapping of the COs and POs

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

PLC and SCADA

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electrical	3-0-0, (3)	Open Elective	EL108305EL

[Pre-requisites: Basic Electrical Engineering Code (EL10I022EL)]

Course Objectives

1. To know the importance and benefits of automation and to understand how to automate an industrial process using PLC
2. To program PLC using the Ladder diagrams.
3. Be aware of applications of timers, counters and effective use of program flow control instructions to manage PLC operations
4. Appreciate the need for SCADA in Process Control Instrumentation

Course Content

UNIT 1 PLC and I/O Processing

Programmable Logic Controller basics, overview of PLC systems – Architecture of PLC, Principle of Operation, input/output **Unit**s – power supplies and isolators, current sinking and current sourcing, types of PLC memory, fundamental PLC wiring diagram, relays, switches, transducers, sensors –seal-in circuits. Input/output units Signal conditioning. Remote connections Networks Processing inputs I/O addresses

Unit 2 Programming of PLC

Fundamentals of logic, PLC programming languages. Ladder diagrams, Ladder Diagram Instruction, Logic functions, Latching, Multiple outputs. **Timer and counter-** types along with timing diagrams, shift registers, sequencer function, latch instruction; Arithmetic and logical instruction with various examples. ON/OFF switching devices, I/O analog devices, Analog PLC operation, PID control of continuous processes, simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID), PLC interface, and Industrial process example

Unit 3 PLC interface to various circuits

Encoders, transducer and advanced sensors. Measurement of temperature, flow, pressure, force, displacement, speed, level. Developing a ladder logic for Sequencing of motors, Tank level control, ON-OFF temperature control, elevator, bottle filling plant, car parking etc. Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

Unit 4 SCADA System

Introduction, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution). Open systems interconnection (OSI) Model, Process Field bus (Profibus). Interfacing of SCADA with PLC.

Course Materials

Required Text: Textbooks

1. GaryDunning,"IntroductiontoProgrammableLogicControllers",Thomson,2ndEdition.
2. John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications", PHI Publishers.
3. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition.
4. StuartABoyer,"SCADAsupervisorycontrolanddataacquisition",ISA,4thRevisededition
5. L.A.Bryan,E.A.Bryan,"ProgrammableControllersTheoryandImplementation"IndustrialText Company Publication, Second Edition.
6.

Optional Materials: Reference Books

1. Stuart A. Boyer: "SCADA- Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, The Instrumentation system and Automation Society, 4th Edition, 2010.
2. Gordon Clarke, Deon Reynders" *Practical Modern SCADA Protocols: DNP3, 60870.5 and*

RelatedSystems", Newnes An imprint of Elsevier Publications, 1st Edition, 2004
3. Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition
4. GordanClark,DeemReynders,"PracticalModernSCADAProtocols",ELSEVIER

Course Outcomes

1. Appraise the concept of PLC and SCADA and their role in our society.
2. Understand the operating concept, components and application of PLC and SCADA.
3. Interpret the concept, application and analyze the performance of Automatic substation control and power distribution.
4. Acquire the knowledge of construction, application and performance of hybrid energy system.
5. Infer the concept and utility of Open systems interconnection (OSI) Model, Process Field bus (Profibus).

Mapping of COs and POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2			3	3	3			3	3
CO2	3	3	3	3	2	3	3		2		3	3
CO3	3	3	3	3	2	3	3		2		3	3
CO4	3	3	3	3	2	3	3		2		3	3
CO5	2	2	2	1		3	3	3	3		3	3

Mechatronics

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electrical Engineering	3-0-0, (3)	Open Elective	EL108306EL

[Pre-requisites: Basic Electrical Engineering (EL101022EL), Physics II(PH101006PH)]

Course Objectives

1. To integrate concepts of electrical, mechanical and computer engineering in the design of mechatronics systems.
2. To be able to design, build, interface and control a mechatronic system for a set of specifications.

Course Content

Unit 1 Mechatronic system

Mathematical modeling of electrical, mechanical, electromechanical systems, pneumatic and thermal systems; Passive and active elements, lumped and distributed systems, Electromechanical energy conversion.

Unit 2 Sensors and actuators

Measurement devices; operation of sensor, transmitter and transducer; Classification and calibration of sensors; Displacement, position and motion sensors, Actuators; Electrical actuating devices, Industrial automation and PLC.

Unit 3 Signal conditioning and data acquisition system

Analog signal conditioning; Digital signal conditioning, Analog and Digital Data Acquisition Systems, Voltage, Current, Frequency, Temperature, Displacement, Pressure measurement using Data Acquisition System (DAS), Design of signal conditioning circuits, Application of Data Acquisition System in Power plant, Data Logger.

Unit 4 Embedded systems

8086 Microprocessor architecture; Assembly language instruction and programming; 8051 Microcontroller; 8085 / 8086 / 8051 Interfacing, Digital signal processor and FPGA.

Course Materials

Required Text: Text books

1. Curtis D. Johnson, "Process Control Instrumentation Technology",Pearson Education India, 8th edition, 2015.
2. D. Patranabis, "Sensors and Transducers", Prentice Hall India Learning Private Limited, 2nd edition 2003.
3. A.K. Ray &K.M.Bhurchandi, "Advanced Microprocessors and peripherals- Architectures, Programming and Interfacing", McGraw-Hill Education (India) ,2009.

Course Outcomes

1. Appreciate the significance of monitoring, signal conditioning and computer interfacing for improving the reliability and performance of mechanical systems
2. Infer the steps in PLC based industrial automation
3. Write common programs in microcontroller and by using ladder logic
4. Design the various components of a mechatronic system for a given set of specification

Mapping of COs and POs

POs / COs	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	3	2	3	2	2	2	2		2	3
2	2	3	3	2	3	2		2	2		2	3
3	2	3	3	2	3	2					2	3
4	3	3	3	2	3	2	2	2	2		2	3