

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR
SEMESTER SCHEME-2020-21



V SEMESTER
(SESSION 2021-2022 & ONWARDS)

MICROCONTROLLER APPLICATIONS

Subject Code		EE 5001
Course Title	:	Microcontroller Applications
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PC

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 different types of microcontroller based 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:

- Interpret the salient features of various types of microcontrollers.
- Interpret the salient features of architype of types microcontrollers IC 8051
- Maintain the program features of the Microcontroller based application
- Develop assembly language program
- Develop programs to interface 8051 microcontrollers with LED/SWITCH

COURSE CONTENTS**1. INTRODUCTION TO MICROCONTROLLERS**

- Evolution of Microcontrollers
- Block diagram of Microcomputer,
- elements of Microcomputer,
- types of buses
- Von Neuman and Harward Architecture
- Compare Microprocessor and Microcontrollers
- Need of Microcontroller
- Family of Microcontrollers and their specifications

2. ARCHITECTURE OF MICROCONTROLLER 8051

- Block diagram of 8051,
- function of each block
- Pin diagram, function of each pin
- Concept of Internal memory and External memory (RAM and ROM)
- Internal RAM structure
- Reset and clock circuit

3. 8051 INSTRUCTION SET AND PROGRAMS

- Overview of 8051 instruction set
- Various addressing modes
- Classification of instructions
 - Data transfer instructions
 - Arithmetic instructions
 - Logical instructions
 - Branching instructions
 - Bit manipulation instructions
 - Stack, subroutine and interrupt related instructions

4. ASSEMBLY LANGUAGE PROGRAMMING

- Software development steps
- Software development tools like Editor, Assembler, Linker, Loader and Hex converters.
- Role of various files created at various levels in running a Assembly program using simulators like RIDE or KEIL.
- Various directives of Assembly language programming

5. 8051 INTERNAL PERIPHERALS AND RELATED PROGRAMS

- 5.1. I/O ports- List, diagram, read write operation, instructions and related SFRs
- 5.2. Timers/counters – list, related SFRs, programming modes, operations with diagram.
- 5.3. Serial communication- Basics of serial communication, baud rate, related SFRs,

REFERENCES:

- 1. Kenneth, Ayala, 8051 Microcontroller Architecture Programming and Application, PHI Learning, New Delhi, ISBN: 978-1401861582
- 2. Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; Mckinlay Roline D., The 8051 Microcontroller and Embedded system, Pearson Education, Delhi, ISBN 978-8177589030
- 3. Pal, Ajit, Microcontroller Principle and Application, PHI Learning, New Delhi, ISBN13: 978-81-203-4392-4
- 4. Deshmukh, Ajay, Microcontroller Theory and Application, McGraw Hill., New Delhi, ISBN-[9780070585959](#)
- 5. Kamal, Raj, Microcontroller Architecture Programming, Interfacing and System Design, Pearson Education India, Delhi, ISBN: 9788131759905
- 6. Mathur; Panda, Microprocessors and Microcontrollers, PHI Learning, New Delhi, ISBN:978-81-203-5231-5
- 7. Krishna Kant, Microprocessors and Microcontrollers: Architecture programming and System Design, PHI Learning, New Delhi, ISBN:978-81-203-4853-0

ENERGY CONSERVATION AND AUDIT

Course Code	:	EE 5002
Course Title	:	Energy Conservation and Audit
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Undertake energy conservation and energy audit.

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:

- Interpret energy conservation policies in India.
- Implement energy conservation techniques in electrical machines.
- Apply energy conservation techniques in electrical installations.
- Use Co-generation and relevant tariff for reducing losses in facilities.
- Undertake energy audit for electrical system.

COURSE CONTENTS**1. ENERGY CONSERVATION BASICS**

- Energy Scenario: Primary and Secondary Energy, Energy demand and supply,
- National scenario.
- Energy conservation and Energy audit; concepts and difference
- Indian Electricity Act 2001;
- relevant clauses of energy conservation

2. ENERGY CONSERVATION IN ELECTRICAL MACHINES

- Need for energy conservation in induction motor and transformer.
- Energy conservation techniques in induction motor by:
 - Improving Power quality.
 - Motor survey
 - Matching motor with loading.
 - Rewinding of motor.
 - Replacement by energy efficient motor
 - Periodic maintenance
- Energy conservation techniques in Transformer.
 - Loading sharing
 - Parallel operation
 - Isolating techniques.
 - Replacement by energy efficient transformers.
 - Periodic maintenance.
- Energy Conservation Equipment:
 - Soft starters,
 - Automatic star delta convertor,
 - Variable Frequency Drives,
 - Automatic p. f. controller (APFC),
 - Intelligent p. f. controller (IPFC)
- Energy efficient motor; significant features, advantages, applications and limitations.

3. ENERGY CONSERVATION IN ELECTRICAL INSTALLATION SYSTEMS

- Aggregated Technical and commercial losses (ATC);
- Power system at state, regional, national and global level.
- Technical losses; causes and measures to reduce by.

- 3.3.1. Controlling I^2R losses.
- 3.3.2. Optimizing distribution voltage
- 3.3.3. Balancing phase currents
- 3.3.4. Compensating reactive power flow
- 3.4. Commercial losses: pilferage, causes and remedies
- 3.5. Energy conservation equipment:
 - 3.5.1. Maximum Demand Controller ,
 - 3.5.2. kVAR Controller,
 - 3.5.3. Automatic Power Factor controller(APFC)
- 3.6. Energy Conservation in Lighting System
 - 3.6.1. Replacing Lamp sources.
 - 3.6.2. Using energy efficient luminaries.
 - 3.6.3. Using light controlled gears.
 - 3.6.4. Periodic survey and adequate maintenance programs.
- 3.7. Energy Conservation techniques in fans, Electronic regulators.

4. ENERGY CONSERVATION THROUGH COGENERATION AND TARIFF

- 4.1. Co-generation and Tariff; concept, significance for energy conservation
- 4.2. Co-generation Types of cogeneration on basis of sequence of energy use (Topping cycle, Bottoming cycle)
- 4.3. Types of cogeneration basis of technology (Steam turbine cogeneration, Gas turbine cogeneration, Reciprocating engine cogeneration).
- 4.4. Tariff: Types of tariff structure:
 - 4.4.1. Special tariffs;
 - 4.4.2. Time-off-day tariff,
 - 4.4.3. Peak-off-day tariff,
 - 4.4.4. Power factor tariff,
- 4.5. Application of tariff system to reduce energy bill.

5. ENERGY AUDIT OF ELECTRICAL SYSTEM

- 5.1. Energy audit (definition as per Energy Conservation Act)
- 5.2. Energy audit instruments and their use.
- 5.3. Energy Audit procedure (walk through audit and detailed audit).
- 5.4. Energy Audit report format.

REFERENCES:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN: 978-0195606539
4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
5. Sharma, K. V., [Venkateshaiah](#); P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
6. Mehta, V. K., Principles of Power System, S. Chand & Co. New Delhi, 2016, ISBN 9788121905947
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K Kataria & Sons, New Delhi ISBN-13: 9789350141014.
8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
9. [Chakrabarti](#), Aman, Energy Engineering And Management, e-books Kindle Edition

ECONOMIC POLICIES IN INDIA

Course Code	EE 51001 (Same in All Branches of Engg.)
Course Title	Economic Policies in India
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES:

The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

CO1	Understand Indian economics policy, planning strategies
CO2	It will enable to students to comprehend theoretical and empirical development across countries and region for policy purposes
CO3	Development Economics as a discipline encompasses different approach to the problems of unemployment, poverty, income generation, industrialization from different perspectives
CO4	Able to identify the problems and capable to decide the application for future development
CO5	Analyze economic issues and find solutions to complex economic problems and take correct economic judgment

COURSE CONTENTS:**1. BASIC FEATURES AND PROBLEMS OF INDIAN ECONOMY:**

- 1.1. Economic History of India;
- 1.2. Nature of Indian Economy
- 1.3. Demographic features and Human Development Index,
- 1.4. Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India.

2. SECTORAL COMPOSITION OF INDIAN ECONOMY:

- 2.1. Issues in Agriculture sector in India,
- 2.2. land reforms
- 2.3. Green Revolution
- 2.4. agriculture policies of India,

3. INDUSTRIAL DEVELOPMENT,

- 3.1. Small scale and cottage industries,
- 3.2. Industrial Policy,
- 3.3. Public sector in India,
- 3.4. Service sector in India.

4. ECONOMIC POLICIES:

- 4.1. Economic Planning in India,
- 4.2. Planning commission v/s NITI Aayog,
- 4.3. Five Year Plans,
- 4.4. Monetary policy in India,
- 4.5. Fiscal Policy in India,
- 4.6. Centre state Finance Relations,
- 4.7. Finance commission in India
- 4.8. LPG policy in India

5. EXTERNAL SECTOR IN INDIA

- 5.1. India's foreign trade value composition and direction,
- 5.2. India Balance of payment since 1991,
- 5.3. FDI in India,

- 5.4. Impact of Globalization on Indian Economy,
5.5. WTO and India.

REFERENCE BOOKS:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy .S Chand & Co.Ltd. New Delhi.
2. Mishra S. K & V. K Puri (2017). Indian Economy and Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, NewDelhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India ,Oxford University Press.

(Semester Scheme 2020-21)

ENGINEERING ECONOMICS & ACCOUNTANCY

Course Code	EE 51002 (Same in All Branches of Engg.)
Course Title	Engineering Economics & Accountancy
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
Course Category	OE

COURSE OBJECTIVES

- To acquire knowledge of basic economicst of a cilitate the process of economic decision making.
- To acquire knowledge on basic financial management aspects.
- To develop the basic skills to analyze financial statements.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand the macro-economic environment of the business and its impact on enterprise
CO2	Understand cost elements of the product and its effect on decision making
CO3	Prepare accounting records and summarize and interpret the accounting datafor managerial decisions
CO4	Understand accounting systems and analyze financial statements using ratio analysis
CO5	Understand the concepts of financial management and investment

COURSE CONTENTS**1. INTRODUCTION:**

- 1.1. Managerial Economics;
- 1.2. Relationship with other disciplines;
- 1.3. Firms: Types, objectives and goals;
- 1.4. Managerial decisions;
- 1.5. Decision analysis.

2. DEMAND & SUPPLY ANALYSIS:

- 2.1. Demand;
 - 2.1.1. Types of demand;
 - 2.1.2. Determinants of demand;
 - 2.1.3. Demand function;
 - 2.1.4. Demand elasticity;
 - 2.1.5. Demand forecasting;
- 2.2. Supply;
 - 2.2.1. Determinants of supply;
 - 2.2.2. Supply function;
 - 2.2.3. Supply elasticity.

3. PRODUCTION AND COST ANALYSIS:

- 3.1. Production function;
- 3.2. Returns to scale;
- 3.3. Production optimization;
- 3.4. Least cost input; Iso quants;
- 3.5. Managerial uses of production function;
- 3.6. Cost Concepts;
 - 3.6.1. Cost function;
 - 3.6.2. Types of Cost;
 - 3.6.3. Determinants of cost;

- 3.6.4. Short run and Long run cost curves;
- 3.6.5. Cost Output Decision;
- 3.6.6. Estimation of Cost.

4. PRICING:

- 4.1. Determinants of Price;
- 4.2. Pricing under different objectives and different market structures;
- 4.3. Price discrimination;
- 4.4. Pricing methods in practice;
- 4.5. Role of Government in pricing control.

5. FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT):

- 5.1. Balance sheet and related concepts;
- 5.2. Profit & Loss Statement and related concepts;
- 5.3. Financial Ratio Analysis;
- 5.4. Cash flow analysis;
- 5.5. Funds flow analysis;
- 5.6. Comparative financial statements;
- 5.7. Analysis & Interpretation of financial statements;
- 5.8. Investments;
- 5.9. Risks and return evaluation of investment decision;
- 5.10. Average rate of return;
- 5.11. Payback Period;
- 5.12. Net Present Value;
- 5.13. Internal rate of return,

REFERENCE BOOKS:

- 1. Mc Guigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.
- 2. Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.
- 3. Samuelson. Paul A and Nordhaus W. D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
- 4. Pares Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007.
- 5. Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson South Western, 4th Edition, 2001.

SWITCHGEAR AND PROTECTION

Course Code	:	EE 50031
Course Title	:	Switchgear and Protection
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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 switchgear and protection schemes used in electrical power 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:

- Identify various types of faults in power system.
- Select suitable switchgears for different applications.
- Test the performance of different protective relays.
- Maintain protection systems of alternators and transformers.
- Maintain protection schemes for motors and transmission lines.
- Maintain protection schemes for power system against over voltages.

COURSE CONTENTS:**1. BASICS OF PROTECTION**

- Necessity and functions of protective system.
- Normal and abnormal conditions.
- Types of faults and their causes.
- Protection zones and backup protection

2. CIRCUIT INTERRUPTION DEVICES

- Isolators-
 - Vertical break,
 - Horizontal break
 - Pantograph type.
- HRC fuses – Construction, working, characteristics and applications.
- Arc formation process,
- methods of arc extinction (High resistance and Low resistance),
- Arc voltage, Recovery voltage, Re-striking voltage, RRRV.
- Working, and applications of HT circuit breakers
 - (Sulphur-hexa Fluoride (SF₆),
 - Vacuum circuit breaker).
- Working and applications of L.T. circuit breaker
 - Air circuit breakers (ACB),
 - Miniature circuit breakers (MCB),
 - Moulded case circuit breakers (MCCB)
 - Earth leakage circuit breaker (ELCB).
- Selection of LT and HT circuit breakers (ratings),
- Selection of MCCB for motors.

3. PROTECTIVE RELAYS

- Fundamental quality requirements
 - Selectivity,
 - Speed,
 - Sensitivity,
 - Reliability,
 - Simplicity,

- 3.1.6. Economy.
- 3.2. Basic relay terminology of Protective relay –(Only Concept)
 - 3.2.1. Relay time,
 - 3.2.2. Pick up,
 - 3.2.3. Reset current,
 - 3.2.4. current setting,
 - 3.2.5. Plug setting multiplier,
 - 3.2.6. Time setting multiplier.
- 3.3. Protective relays: principle of working, operation of
 - 3.3.1. Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay,
 - 3.3.2. Thermal relay.
 - 3.3.3. working of Static relay.
- 3.4. Over current relay-Time current characteristics.
- 3.5. Microprocessor based over current relays:.
- 3.6. Distance relaying
- 3.7. Directional relay:
- 3.8. Operation of current and voltage differential relay.

4. PROTECTION OF ALTERNATOR AND TRANSFORMER

- 4.1. Alternator Protection –(Only Concept)
 - 4.1.1. Faults,
 - 4.1.2. Differential protection
 - 4.1.3. Over current protection
 - 4.1.4. earth fault protection
 - 4.1.5. overheating protection
 - 4.1.6. field failure protection.
 - 4.1.7. Reverse power protection.
- 4.2. Transformer Protection –(Only Concept)
 - 4.2.1. Faults
 - 4.2.2. Differential protection
 - 4.2.3. over current protection
 - 4.2.4. earth fault protection
 - 4.2.5. over heating protection,
 - 4.2.6. Limitations of differential protection.
 - 4.2.7. Buchholz relay:

5. PROTECTION OF MOTORS, BUS-BAR AND TRANSMISSION LINE

- 5.1. Protection of Motor (Only Concept)
 - 5.1.1. Faults.
 - 5.1.2. Short circuit protection,
 - 5.1.3. Overload protection,
 - 5.1.4. Single phase preventer .
- 5.2. Bus bar and Transmission line (Only Concept)
 - 5.2.1. Faults on Bus bar and Transmission Lines.
 - 5.2.2. Bus bar protection: Differential and Fault bus protection.
 - 5.2.3. Transmission line: Over current, Distance and Pilot wire protection.

REFERENCES:

1. Mehta V. K ;Rohit Mehta, Principles of Power System, S .Chand and Co., New Delhi., ISBN: 978-81-2192-496-2.
2. Rao.Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi, ISBN: 978-81-7409-232-3.
3. Singh, R. P., Switchgear and Power System Protection, PHI Learning, New Delhi, ISBN: 978-81-203-3660-5.
4. Gupta. J. B..Switchgear and Protection, S. K. Kataria and Sons, New Delhi, ISBN: 978-93-5014-372-8.
5. Veerapan, N.,Krishnamurty, S. R., Switchgear and Protection, S .Chand and Co., New Delhi. ISBN: 978-81-2193-212-7.

6. Ram, Badri; Vishwakarma D. N., Power System Protection and Switchgear, McGraw-Hill, New Delhi.
ISBN : 978-07-107774-X

(Semester Scheme 2020-21)

ELECTRICAL TESTING AND COMMISSIONING

Course Code	:	EE 50032
Course Title	:	Electrical Testing and Commissioning
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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 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:

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

COURSE CONTENTS:**1. 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,
- Measuring insulation resistance by different methods and to predict the condition of insulation
 - Polarization,
 - Dielectric absorption,
 - Megger

2. 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
- Requirements of installation of pole mounted transformer

3. TESTING AND COMMISSIONING

- Concept of testing,
- Objectives of testing.
- Roles of I.S.S. in testing of electrical equipment,
- Methods of testing - Direct/Indirect/Regenerative testing.
- 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

4. TROUBLESHOOTING PLANS

- 4.1. Internal and external causes for failure / abnormal operation of equipment.
- 4.2. List of mechanical faults, electrical faults and magnetic faults in the electrical equipment remedies, applications
- 4.3. Use of tools like bearing puller filler gauges, dial indicator, spirit level, megger, earth tester, and growler.
- 4.4. Common troubles in electrical equipments and machines.

5. MAINTENANCE

- 5.1. Concept of maintenance,
- 5.2. types of maintenance,
- 5.3. Routine, preventive and breakdown maintenance.
- 5.4. Causes of failure of electrical machines
- 5.5. Preventive maintenance-procedure or developing maintenance schedules for electrical machines.
- 5.6. Maintenance schedules of the following as per I.S.S.
 - 5.6.1. Distribution transformer as per I.S.1886-1967
 - 5.6.2. Single phase and three phase Induction motors as per I.S.900-1965.
 - 5.6.3. 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

ELECTRIC TRACTION

Course Code	:	EE 50041
Course Title	:	ELECTRIC TRACTION
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

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 traction 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:

- Interpret the traction layout and its systems
- Maintain the power supply arrangements.
- Maintain the function of the overhead equipment for electric traction
- Maintain the different components of the electric locomotive.
- Maintain the traction motor and train lighting system
- Maintain the signalling and supervisory control systems.

COURSE CONTENTS:**1. BASICS OF TRACTION**

- General description of Electrical Traction system in India.
- Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive
- Problems associated with AC traction System and remedies for it.

2. POWER SUPPLY ARRANGEMENTS

- Constituents of supply system:-
 - Substation: layout, list of equipment and their functions
 - Feeding post: list of equipment and their functions
 - Feeding and sectioning Arrangements
 - Sectioning and paralleling post
 - Sub sectioning and Paralleling post
 - Sub sectioning post
 - Elementary section
- Major equipment at substation,
- Protection system for traction transformer and 25 kV centenary construction

3. OVERHEAD EQUIPMENT

- Different types of overhead equipments
- Pentagonal OHE Centenary Construction
- Different Types of Centenary according to speed Limit
- Overhead system-
 - Trolley collector,
 - Bow collector,
 - Pantograph Collector

4. ELECTRIC LOCOMOTIVE

- Classification and Nomenclature of Electric Locomotive
- Block diagram of AC locomotive
- Power Circuit of AC Locomotive
- Equipment (List and Function only) used in auxiliary circuit of AC Locomotive
- Maintenance of AC systems

5. TRACTION MOTORS AND TRAIN LIGHTING

- 5.1. Desirable characteristics of traction motor.
- 5.2. Types of motors used for traction with their characteristics and features
- 5.3. Control of motors used for traction and methods to control
- 5.4. Requirements of braking,
- 5.5. types of braking
 - 5.5.1. Electric braking,
 - 5.5.2. Regenerative braking
- 5.6. Systems of train lighting,
 - 5.6.1. Single battery,
 - 5.6.2. double battery
 - 5.6.3. parallel block system

6. SIGNALLING AND SUPERVISORY CONTROL

- 6.1. Requirements of signaling systems
- 6.2. Types of signals,
- 6.3. track circuits
- 6.4. Advantages of remote control

REFERENCES:

- 1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
- 2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
- 3. Partab H., DhanpatRai and Co,' Art and Science of Utilization of Electrical Energy
- 4. Partab H., DhanpatRai and Co, Modern Electric Traction
- 5. Suryanarayana N.V., New Age International Publishers, Reprint 2010
- 6. Open Shaw Taylor, Orient Longman Ltd., Utilisation of electrical energy.

INDUSTRIAL DRIVES

Course Code	:	EE 50042
Course Title	:	INDUSTRIAL DRIVES
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

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 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 DC Drives.
- Maintain AC Drives.
- Maintain microprocessor/micro controlled electric motors.

COURSE CONTENTS:**1. ELECTRIC DRIVES –(Basic idea)**

- 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.

2. 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
- Maintenance procedure.

3. DC DRIVES

- Single phase SCR Drives
 - Half wave converter
 - Full wave converter
 - Semi converter
 - Dual converter
- Three Phase SCR Drives
 - Half wave converter

- 3.2.2. Full wave converter
- 3.2.3. Semi converter
- 3.2.4. Dual converter
- 3.3. Reversible SCR Drives.
- 3.4. Speed control methods of DC series Motor
- 3.5. Maintenance procedure.

4. AC DRIVES

- 4.1. Starting and Braking of Induction motors.
- 4.2. Stator voltage control
- 4.3. Variable Frequency Control
- 4.4. Voltage Source Inverter Control
- 4.5. Current Source Inverter Control
- 4.6. Rotor Resistance Control
- 4.7. Slip Power Recovery
- 4.8. Solar powered pump drives
- 4.9. Maintenance procedure for AC drives

5. ADVANCED TECHNIQUES OF MOTOR CONTROL

- 5.1. Microcontroller/ Microprocessor based control for drives
- 5.2. Phase locked loop control of DC motor.
- 5.3. AC/DC motor drive using Microcomputer control
- 5.4. AC/DC motor drive using Microcontroller control.
- 5.5. Synchronous Motor drives.

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MICROCONTROLLER APPLICATIONS LAB.

Course Code	:	EE 5005
Course Title	:	Microcontroller Applications Lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

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 microcontroller based 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:

- Interpret the salient features of various types of microcontrollers.
- Interpret the salient features of architype of types microcontrollers IC 8051
- Maintain the program features of the Microcontroller based application
- Develop assembly language program
- Develop program to interface 8051 microcontrollers with LED/SWITCH

PRACTICALS:

- Interpret details of Hardware kit for Microcontroller and practice to write and execute programs.
- Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use.
- Develop and execute Assembly language programs using Arithmetic Instructions and demonstrate outcome for a given input data
- Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input
- Develop and execute an Assembly language program for Addition of series of 8 bit nos, 16 bit result and demonstrate outcome for a given input data
- Develop and execute Assembly language program for addition/subtraction of 16 bit no/multibyte nos. and demonstrate outcome for a given input data
- Develop and execute Assembly language program for Block transfer from and to Internal/External memory using directives and demonstrate outcome for a given input data.
- Develop and execute Assembly language program Largest/smallest of given series of no. from Internal/External memory and demonstrate outcome for a given input data.
- Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data.
- Develop and execute Assembly language program for LED blinking/LED sequences using delay/timer mode.
- Develop and execute Assembly language program to interface LED with microcontroller.

ENERGY CONSERVATION AND AUDIT LAB.

Course Code	:	EE 5006
Course Title	:	Energy Conservation and Audit Lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PC

COURSE OBJECTIVES:

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

- Undertake energy conservation and energy audit.

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:

- Interpret energy conservation policies in India.
- Implement energy conservation techniques in electrical machines.
- Apply energy conservation techniques in electrical installations.
- Use Co-generation and relevant tariff for reducing losses in facilities.
- Undertake energy audit for electrical system.

PRACTICALS:

- Identify star labelled electrical apparatus and compare the data for various star ratings.
- Determine the '% loading' of the given loaded Induction motor.
- Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.
- Use APFC unit for improvement of p. f. of electrical load.
- Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.
- Determine the reduction in power consumption by replacement of lamps in a class room / laboratory.
- Determine the reduction in power consumption by replacement of Fans and regulators in a class room / laboratory.
- Collect electricity bill of an industrial consumer and suggest suitable tariff for energy conservation and its impact on energy bill.
- Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill.
- Collect electricity bill of a residential consumer and suggest suitable means for conservation and reduction of the energy bill.
- Estimate energy saving by improving power factor and load factor for given cases.
- Prepare a sample energy audit questionnaire for the given industrial facility.
- Prepare an energy audit report (Phase-I)
- Prepare an energy audit report (Phase-II)
- Prepare an energy audit report (Phase-III)

SWITCHGEAR AND PROTECTION LAB.

Course Code	:	EE 50071
Course Title	:	Switchgear and Protection Lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PE

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 switchgear and protection schemes used in electrical power 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:

- Identify various types of faults in power system.
- Select suitable switchgears for different applications.
- Test the performance of different protective relays.
- Maintain protection systems of alternators and transformers.
- Maintain protection schemes for motors and transmission lines.
- Maintain protection schemes for power system against overvoltages.

PRACTICALS:

- Identify various switchgears in the laboratory and write their specifications.
- Test HRC fuse by performing the load test.
- Test MCB by performing the load test
- Dismantle MCCB/ELCB and identify various parts.
- Dismantle ACB/VCB and identify different parts.
- Set the plug and time (with PSM, TSM) of induction type electromagnetic relay.
- Test electromagnetic over-current relay by performing load test.
- Simulate differential protection scheme for transformer with power system simulation kit.
- Test the working of the single phasing preventer using a three phase induction motor.
- Simulate transmission line protection by using the impedance relay/over current relay for various faults.
(On transmission line protection simulation Kit).
- Dismantle Thyrite type arrester and identify different parts.
- Perform neutral earthing at different substations / locations.

ELECTRICAL TESTING AND COMMISSIONING LAB.

Course Code	:	EE 50072
Course Title	:	Electrical Testing and Commissioning Lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	NIL
Course Category	:	PE

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 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:

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

PRACTICALS:

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

ELECTRIC TRACTION LAB.

Course Code	:	. EE 50081
Course Title	:	Electric Traction Lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

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 traction 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:

- Interpret the traction layout and its systems
- Maintain the power supply arrangements.
- Maintain the function of the overhead equipment for electric traction
- Maintain the different components of the electric locomotive.
- Maintain the traction motor and train lighting system
- Maintain the signalling and supervisory control systems.

PRACTICALS:

- Dismantle a traction motor
- Assemble a traction motor
- Troubleshoot a traction motor
- Visit electric-traction train lighting system installation, identify components of system and prepare report
- Visit electric-traction loco shed, investigate working of each section & prepare report
- Visit to Traction Substation or feeding post (for layout and OHE) and write a report
- Visit to Railway Station (for signalling and train lighting) and writing a report on visit
- Draw traction substation Layout on drawing sheet and prepare report
- Draw Pentagonal OHE Catenary, different Catenaries according to speed limit, OHE supporting structure on drawing sheet and prepare report
- Draw Power Circuit of AC Locomotive on drawing sheet and prepare report.

INDUSTRIAL DRIVES LAB.

Course Code	:	EE 50082
Course Title	:	Industrial Drives lab.
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

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 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 DC Drives.
- Maintain AC Drives.
- Maintain microprocessor/micro controlled electric motors.

PRACTICALS:

- Dismantle the given DC motor and identify its different parts
- Dismantle the given AC motor and identify its different parts
- Control the speed of DC Motor using armature voltage control method
- Control the speed of DC Motor using field current control method
- Measure the output voltage of chopper for resistive load by varying the frequency and /or duty cycle of chopper.
- Control the speed of three phase squirrel cage induction motor using stator voltage control method.
- Effect on speed of given D.C. series motor by varying armature voltage using step down chopper.
- Observe the effect on speed of the given D.C. separately excited motor by varying voltage using step down chopper.
- 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.
- Control the speed of the given separately excited motor by changing the firing angle of SCR using single phase full converter and measure the speed
- Control the speed of the given three phase induction motor by using constant V/f method and plot the graph between speed and frequency.
- Control the speed of the given three phase induction motor by varying frequency and plot the graph between speed and frequency
- Control the speed of the given synchronous motor drives using microcontroller.
- Demonstrate High power SCR/power device and Heat sink and write their specifications and rating.
- Control the speed of single phase capacitor split phase induction motor using DIAC –TRIAC circuit.
- Control the speed of DC motor drives using microcontroller.
- Identify different parts and assemble the given DC motor.
- Identify different parts and assemble the given AC motor.
