FUNDAMENTALS OF POWER ELECTRONICS

Course Code	EE 4001
Course Title	Fundamentals of Power Electronics
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	None
Course Category	PC

COURSE OBJECTIVES

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

- Maintain the proper functioning of power electronic devices.

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:

1. Select power electronic devices for specific applications.
2. Maintain the performance of Thyristors...
3. Troubleshoot turn-on and turn-off circuits of Thyristors.
4. Maintain phase controlled rectifiers.
5. Maintain industrial control circuits.

COURSE CONTENTS

1. POWER ELECTRONIC DEVICES

1.1 Power Transistors: Construction, working principle, V-I characteristics and uses.

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

2. THYRISTOR FAMILY DEVICES

2.1 SCR:

- 2.1.1 Construction.
- 2.1.2 Two transistor analogy.
- 2.1.3 Types, working and characteristics.
- 2.1.4 SCR mounting and cooling.

2.2 Types of Thyristors: Thyristor family devices: Symbol, construction, operating principle and V-I characteristics.

- 2.2.1 SCR
- 2.2.2 SCS
- 2.2.3 GTO
- 2.2.4 UJT
- 2.2.5 PUT
- 2.2.6 DIAC
- 2.2.7 TRIAC

2.3 Protection Circuits:

- 2.3.1 Over-voltage
- 2.3.2 Over-current
- 2.3.3 Snubber
- 2.3.4 Crowbar

3. TURN-ON AND TURN-OFF METHODS OF THYRISTORS

3.1 SCR Turn-on methods:

- 3.1.1 High Voltage thermal triggering
- 3.1.2 Illumination triggering
- 3.1.3 dv/dt triggering
- 3.1.4 Gate triggering: Gate trigger circuits:
  - 3.1.4.1 Resistance

3.1.4.2 Resistance –Capacitance circuits.
3.1.5 SCR triggering using UJT, PUT:
3.2 SCR Turn-off methods:
3.2.1 Class A – Series resonant commutation circuit
3.2.2 Class B – Shunt Resonant commutation circuit
3.2.3 Class C – Complimentary Symmetry commutation circuit
3.2.4 Class D – Auxiliary commutation
3.2.5 Class E – External pulse commutation
3.2.6 Class F – Line or natural commutation

4. PHASE CONTROLLED RECTIFIERS

4.1 Phase control: Firing angle, conduction angle...
4.2 Circuit diagram, working, input – output waveforms, equations for DC output and effect of freewheeling diode. For
4.2.1 Single phase half controlled
4.2.2 Full Controlled
4.2.3 Midpoint controlled rectifier with R, RL Load

5. INDUSTRIAL CONTROL CIRCUITS

5.1 Applications:
5.1.1 Burglar's alarm system
5.1.2 Battery charger using SCR
5.1.3 Emergency light system
5.1.4 Temperature controller using SCR
5.1.5 Illumination control / fan speed control TRIAC
5.1.6 SMPS

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. Bhattacharys, 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.

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ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

Course Code	EE 4002
Course Title	Electrical Power Transmission And Distribution
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	None
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 the proper functioning of the electrical transmission and distribution 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:

1. Interpret the normal operation of the electric transmission and distribution systems.
2. Maintain the functioning of the medium and high voltage transmission system.
3. Interpret the parameters of the extra high voltage transmission system.
4. Maintain the functioning of the low voltage AC distribution system.
5. Maintain the components of the transmission and distribution lines.

COURSE CONTENTS

1. **BASICS OF TRANSMISSION AND DISTRIBUTION**
   - 1.1 Single line diagrams with components of the electric supply transmission and distribution systems.
   - 1.2 Classification of transmission line: based on type of voltage, voltage level, length and others.
   - 1.3 Primary and secondary transmission.
   - 1.4 Standard voltage level used in India.
   - 1.5 Characteristics of high voltage for power transmission.
   - 1.6 Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV.
   - 1.7 Method of construction of electric supply distribution systems – 220 V, 400 V, 11 kV, 33 kV.

2. TRANSMISSION LINE PARAMETER AND PERFORMANCE

- 2.1 Line Parameters: Concepts of R,L and C of line parameters and types of lines.
- 2.2 Performance of short line: Efficiency, regulator and its derivation, effect of power factor, vector diagram for different power factor.
- 2.3 Transposition of conductors and its necessity.
- 2.4 Skin effect, ferrenti effect and proximity effect.

3. EXTRA HIGH VOLTAGE TRANSMISSION

- 3.1 Extra High Voltage AC (EHVAC) transmission line: Necessity.
- 3.2 High voltage substation components such as transformers and other switchgears.
- 3.3 Advantages, limitations and applications of it
- 3.4 EHVAC lines in India.
- 3.5 Corona effect.
- 3.6 High Voltage DC (HVDC) Transmission line: Necessity, components, advantages, limitations and applications.
- 3.7 Layout of mono-polar, bi-polar, homo-polar transmission lines.
- 3.8 HVDC Lines in India.
- 3.9 Features of EHVAC and HVDC transmission lines.

4.AC DISTRIBUTION SYSTEM

- 4.1 Components classification, requirements of an ideal distribution system.
- 4.2 Primary and secondary distribution system.

4.3 Feeder and distributor.
4.4 Factors to be considered in design of feeder and distributor.
4.5 Types of different distribution schemes: Radial, ring and grid layout.
4.6 Distribution Sub-Station:
4.6.1 Classification.
4.6.2 Site selection.
4.6.3 Advantages, disadvantages and application.
4.7 Single Line diagram (Layout)of 33/11 KV Sub-Station, 11KV/400V sub-station.
4.8 Symbols and functions of their components.

5. COMPONENTS OF TRANSMISSION AND DISTRIBUTION LINE

5.1 Overhead Conductors:
5.1.1 Properties of material.
5.1.2 Types of conductor with trade names.
5.1.3 Significance of sag.
5.2 Line supports:
5.2.1 Requirements.
5.2.2 Types of line structure and their specifications.
5.3 Line insulators:
5.3.1 Properties of insulating material.
5.3.2 Selection of material.
5.3.3 Types of insulators and their applications.
5.3.4 Causes of insulators failure.
5.3.5 Derivation of equation of string efficiency for string of three suspension insulator.
5.4 Underground Cables:
5.4.1 Requirements.
5.4.2 Classification
5.4.3 Construction.
5.4.4 Comparison with overhead lines.
5.4.5 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”, DhanpatRai 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

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INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRICAL MACHINES

Course Code	EE 4003
Course Title	Induction, Synchronous and Special Electrical Machines
Number of Credits	3 (L-2, T-1, P-0)
Prerequisites	None
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 Induction, Synchronous and FHP Machines used in different application.

COURSE OUTCOME

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.

COURSECONTENTS

1. THREE PHASE INDUCTION MOTOR::

- 1.1 Working principle.
- 1.2 Production of rotating magnetic field.
- 1.3 Synchronous speed.
- 1.4 Rotor.
- 1.5 Slip
- 1.6 Construction of 3-phase induction motors:
  - 1.6.1 Squirrel cage induction motor.
  - 1.6.2 Slip ring induction motor
- 1.7 Rotor qualities :
  - 1.7.1 Frequency
  - 1.7.2 Induction emf.
  - 1.7.3 Power factor at starting and running condition.
- 1.8 Characteristics of torque versus slip (speed)
- 1.9 Torques: starting, full load and maximum with relations among them.
- 1.10 Induction motor as a generalized transformation with phasor diagram.
- 1.11 Starters:
  - 1.11.1 Need and types.
  - 1.11.2 Stator resistance
  - 1.11.3 Auto transformer
  - 1.11.4 Star delta.
  - 1.11.5 Rotor Resistance.
- 1.12 Maintenance of three phase induction motors.

2. SINGLE PHASE INDUCTION MOTORS

- 2.1 Double field revolving theory.
- 2.2 Principle of making these motors self-start.
- 2.3 Construction, working and Torque-speed characteristics of following motors:
  - 2.3.1 Resistance start induction run.
  - 2.3.2 Capacitor start induction run.

2.3.3 Capacitor start capacitor run.
Introduction of:
2.3.4 Shaded pole.
2.3.5 Repulsion type.
2.3.6 Series motor.
2.3.7 Universal motor.

2.4 Motor selection for different applications as per the load torque-speed requirements.
2.5 Maintenance of single phase induction motors.

3. **THREE PHASE ALTERNATORS**

3.1 Principle of working
3.2 Moving and stationary armatures.
3.3 Constructional details:
3.3.1 Part and their functions
3.3.2 Rotor Constructions.
3.3.3 Windings: Single and double layer.
3.4 Alternator loading
3.4.1 Factor affecting the terminal voltage of alternator.
3.4.2 Armature resistance and leakage reactance drops.
3.5 Armature reaction at various power factors
3.6 Maintenance of alternator

4. **SYNCHRONOUS MOTOR**

4.1 Principle of working /operation.
4.2 Significance of load angle.
4.3 Torque: starting torque, running torque, pull in torque, pull out torque.
4.4 Synchronous motor on load with constant excitation (No numerical).
4.5 Methods of starting of Synchronous Motor.
4.6 Losses in synchronous motors and efficiency (No numerical).

5. **FRACTIONAL HORSE POWER (FHP) MOTORS**

5.1 Construction, working and application of following motors:
5.1.1 BLDC.
5.1.2 Permanent Magnet Synchronous Motor.
5.1.3 Stepper motors.
5.1.4 AC and DC servomotors.

REFERENCES /SUGGESTED LEARNING RESOURCES:

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

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INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING

Course Code	EE 40041
Course Title	Industrial Instrumentation and Condition Monitoring
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	None
Course Category	PE

COURSE OBJECTIVES

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

- Use instrumentation equipment for condition monitoring and control.

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 instruments used for measuring electrical and non-electrical quantities.
b) Select relevant transducers/sensors for various applications.
c) Use relevant instruments for measuring non-electrical quantities.
d) Check the signal conditioning and telemetry system for their proper functioning.

COURSE CONTENTS

1 FUNDAMENTALS OF INSTRUMENTATION

- 1.1 Basic purpose of instrumentation
- 1.2 Basic block diagram (transduction, signal conditioning, signal presentation) and their function.
- 1.3 Construction, working and application of switching devices:
  - 1.3.1 Push button.
  - 1.3.2 Limit switch.
  - 1.3.3 Float switch.
  - 1.3.4 Pressure switch.
  - 1.3.5 Thermostat.
  - 1.3.6 Electro magnetic relay.

2 TRANSDUCERS

- 2.1 Distinguish between
  - 2.1.1 Primary and secondary transducers.
  - 2.1.2 Electrical and Mechanical.
  - 2.1.3 Analog and Digital.
  - 2.1.4 Active and Passive.
  - 2.1.5 Mechanical devices.
- 2.2 Advantages of electric transducers.
- 2.3 Factors affecting the choice of transducers.
- 2.4 Construction and principle of resistive transducers.
  - 2.4.1 Potentiometer – variac
  - 2.4.2 Strain gauges –(No derivation, only definition and formula for gauge factor)
    - 2.4.2.1 Types of strain gauges
      - 2.4.2.1.1 Unbonded
      - 2.4.2.1.2 Bonded
      - 2.4.2.1.3 Semiconductor
- 2.5 Construction and principle of following transducers-
  - 2.5.1 L.V.D.T
  - 2.5.2 R.V.D.T
  - 2.5.3 Photoconductive cells.
  - 2.5.4 Photo voltaic cells.

3 MEASUREMENT OF NON – ELECTRIC QUANTITIES

- 3.1 Temperature measurement –
  - 3.1.1 Construction, working, technical specification and ranges of

3.1.1.1 RTD
3.1.1.2 Thermistor
3.1.1.3 Thermocouple

3.2 Pressure measurement
3.2.1 Construction and working of
3.2.1.1 Bourdon tube
3.2.1.2 Bellow diaphragm
3.2.1.3 Strain gauge

3.3 Construction and working of speed measurement by
3.3.1 Contacting and non- contact type –DC tachometer
3.3.2 Photo – electric tachometer
3.3.3 Toothed rotor tachometer generator
3.3.4 Magnetic pickup
3.3.5 Stroboscope

3.4 Construction and working of vibration measurement by accelerometer
3.4.1 LVDT accelerometer
3.4.2 Piezo electric type

3.5 Construction and working of Flow measurement by
3.5.1 Electromagnetic.
3.5.2 Turbine Flow meter.

4 SIGNAL CONDITIONING

4.1 Basic concept of signal conditioning system.
4.2 Draw pin configuration of IC 741.
4.3 Define Ideal OP-AMP and Electrical characteristics of OP-AMP.
4.4 Different parameters of OP-AMP (In brief):
4.4.1 Input offset voltage
4.4.2 Input offset current
4.4.3 Input bias current
4.4.4 Differential input resistance.
4.4.5 CMMR
4.4.6 SVRR
4.4.7 Voltage gain
4.4.8 Output voltage
4.4.9 Slew rate.
4.4.10 Gain.
4.4.11 Bandwidth.
4.4.12 Output.
4.4.13 Short circuit current

4.5 Use of OP-AMP as
4.5.1 Inverting
4.5.2 Non-inverting mode
4.5.3 Adder
4.5.4 Subtractor
4.5.5 Differential Amplifier
4.5.6 Instrumentation amplifier.

REFERENCES

1. Sawhney, A.K. Electric and Electronic Measurement and instrumentation, DhanpatRai and Co. Author, Nineteenth revised edition 2011 reprint, 2014**,** ISBN:10: 8177001000
2. Rangan, C.S. G.R.Sharma. andV.S.V.Mani, Instrumentation devices and system, Pen ram International *Publishing* India Pvt. Ltd. Fifth edition, ISBN:10: 0074633503
3. Mehta, V.K. Electronics and instrumentation, Third edition-S.Chand and company Pvt Ltd Reprint, 2010, ISBN:81-219-2729-3
4. Singh, S.K. Industrial instrumentation and control, Tata McGraw-Hill, 1987. ISBN: 007451914X, 9780074519141.
5. J.G. Joshi, Electronic Measurement and Instrumentation, Khanna Publishing House, New Delhi (ISBN: 978-93-86173-621)

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ILLUMINATION PRACTICES

Course Code	EE 40042
Course Title	Illumination Practices
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	None
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.

- Design illumination schemes and associated electrification of buildings.

COURSE OUTCOME

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 lamps for various applications considering illumination levels
b) Select the lighting accessories required for selected wiring scheme.
c) Design relevant illumination schemes for interior applications.
d) Design Illumination schemes for various applications
e) Design Illumination schemes for various outdoor applications.

COURSECONTENTS

1. FUNDAMENTALS OF ILLUMINATION::

- 1.1 Basic illumination Terminology.
- 1.2 Laws of illumination.
- 1.3 Measurement of illumination.
- 1.4 Lighting calculation methods.
  - 1.4.1 Watt /m^2 method.
  - 1.4.2 Lumens or light flux method.
  - 1.4.3 Point to point method.
- 1.5 Standards for illumination.

2. TYPES OF LAMPS

- 2.1 Incandescent lamp.
- 2.2 ARC Lamps – AC and DC arc lamps.
- 2.3 Fluorescent lamp.
- 2.4 Types of other lamps:
  - 2.4.1 Mercury vapour lamp.
  - 2.4.2 HPMV lamp.
  - 2.4.3 Mercury iodide lamp.
  - 2.4.4 Ultraviolet Lamps.
  - 2.4.5 Neon Sign Tubes.
  - 2.4.6 Metal halides.
  - 2.4.7 HID and Arc lamps.
  - 2.4.8 LED lamps.
  - 2.4.9 CFL
  - 2.4.10 Lasers.
- 2.5 Selection Criteria for lamps.

3. ILLUMINATION FOR INTERIOR APPLICATIONS

- 3.1 Standard for various locations of Interior Illumination.
- 3.2 Design consideration for Interior location of
  - 3.2.1 Residences (1/2/3/4 BHK)
  - 3.2.2 Commercial.
  - 3.2.3 Industrial premises
- 3.3 Illumination scheme for different Interior locations of.

3.3.1 Residential.
3.3.2 Commercial.
3.3.3 Industrial unit.

4. ILLUMINATION FOR EXTERIOR APPLICATIONS

4.1 Factory Lighting.
4.2 Street Lighting (Latest Technology).
4.3 Flood Lighting.
4.4 Railway Lighting.
4.5 Lighting for advertisement.
4.5.1 Hoardings.
4.5.2 Sports Lighting.
4.5.3 Agriculture and Horticulture lighting.
4.5.4 Health Care Centres / Hospitals.
4.5.5 Decorating Purposes.
4.5.6 Stage Lighting.
4.6 Special purpose lamps used in photography video films.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Lindsey, Jack L., Applied Illumination Engineering, The Fairmont Press Inc.
2. Simons, R. H., Bean, Robert; Lighting Engineering: Applied Calculations, Architectural Press. ISBN: 0750650516.
3. Casimer M Decusatis, Handbook of Applied Photometry, Springer, ISBN 1563964163.
4. Butterworths, Lyons Stanley, Handbook of Industrial Lighting, Butterworths
5. Simpson Robert S, Lighting Control Technology and Applications, Focal Press
6. Kao Chen, Energy Management in Illuminating Systems, CRC Press

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ELECTRICAL ESTIMATION AND CONTRACTING

Course Code	EE 40051
Course Title	Electrical Estimation and Contracting
Number of Credits	3 (L-3, T-0, P-0)
Prerequisites	None
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:

- Design electrical installation with costing for tendering.

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.

COURSE CONTENTS

1 ELECTRIC INSTALLATION AND SAFETY

1.1 Scope and features of National electric code 2011.
1.2 Types of electrical installation.
1.3 Fundamental principles for electrical installation.
1.4 Permit to work, safety instructions and safety practices.
1.5 Purpose of estimating and costing

2 ESTIMATION AND COSTING

2.1 Meaning and purpose of -
- 2.1.1 Rough estimate.
- 2.1.2 Detailed estimate.
- 2.1.3 Supplementary estimate.
- 2.1.4 Annual maintenance estimate.
- 2.1.5 Revised estimate

2.2 Factors to be considered while preparation of
- 2.2.1 Detailed estimate.
- 2.2.2 Economical execution of work.

2.3 Tenders and Quotations
- 2.3.1 Type of tender
- 2.3.2 Tender notice
- 2.3.3 Preparation of tender document
- 2.3.4 Method of opening of tender.
- 2.3.5 Quotation.
- 2.3.6 Quotation format.
- 2.3.7 Comparison between tender and quotation.

2.4 Comparative statement.
- 2.4.1 Format comparative statement.
- 2.4.2 Order format.
- 2.4.3 Placing of purchasing order.

2.5 Principles of execution of works
- 2.5.1 Planning , organizing and completion of work.
- 2.5.2 Billing of work.

3 NON-INDUSTRIAL INSTALLATION

3.1 Types of Non-Industrial installation-
- 3.1.1 Office buildings
- 3.1.2 Shopping and commercial centre.
- 3.1.3 Residential installation.
- 3.1.4 Electric service and supply.

3.2 Design consideration of electrical installation in commercial buildings.

4 INDUSTRIAL INSTALLATION

4.1 Classification based on power consumption.
4.2 Drawing of wiring diagram and single line diagram for single phase and three phase motors.
4.3 Design consideration in industrial installation.
4.4 Installation and estimation of agricultural pump and flourmill.

5 PUBLIC LIGHTING INSTALLATION

5.1 Classification of outdoor installations streetlight / public lighting installation.
5.2 Street light pole structures.
5.3 Cables, recommended types and sizes of cable.
5.4 Control of street light installation.
5.5 Design, estimation and costing of streetlight.
5.6 Preparation of tenders and abstracts.

6 **DISTRIBUTION LINES AND LT SUBSTATION**

6.1 Introduction to overhead and underground distribution line.
6.2 Materials used for distribution line HT and LV.
6.3 Cables used for distribution line.
6.4 Cable laying and cable termination method according to IS.
6.5 Design, estimation and costing of HT LT overhead and underground cabling.
6.6 Types of 11 KV distribution substations, their line diagram.

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, DhanpatRai and Sons, Electrical Estimating and Costing, ISBN 13:1234567150995
4. Gupta, J.B. S.K. Kataria and 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

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ELECTRIC VEHICLES

Course Code	:	EE 40052
Course Title	:	Electric Vehicles
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 vehicles

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 salient features of Hybrid electric vehicles.
b) Interpret the Dynamics of hybrid and Electric vehicles
c) Maintain the DC-DC converters in EV applications.
d) Maintain the DC-AC converters in EV applications
e) Select the batteries for EV applications.

COURSE CONTENTS:

1. INTRODUCTION TO HYBRID ELECTRIC VEHICLES

1.1. Evolution of Electric vehicles
1.2. Advanced Electric drive vehicle technology Vehicles-
  1.2.1. Electric vehicles (EV),
  1.2.2. Hybrid Electric drive (HEV),
  1.2.3. Plug in Electric vehicle (PIEV),
1.3. Components used Hybrid Electric Vehicle
1.4. Economic and environmental impacts of Electric hybrid vehicle
1.5. Parameters affecting Environmental and economic analysis
1.6. Comparative study of vehicles for economic, environmental aspects

2. DYNAMICS OF HYBRID AND ELECTRIC VEHICLES

2.1. General description of vehicle movement
2.2. Factors affecting vehicle motion-
  2.2.1. Vehicle resistance,
  2.2.2. tyre ground adhesion,
  2.2.3. rolling resistance,
  2.2.4. aerodynamic drag,
  2.2.5. equation of grading resistance,
  2.2.6. dynamic equation
2.3. Drive train configuration,
2.4. Automobile power train,
2.5. classification of vehicle power plant
2.6. Classification of motors used in Electric vehicles

2.7. types of HEVs
2.8. HEV Configurations-Series, parallel, Series-parallel, complex.

3. DC-DC CONVERTERS FOR EV AND HEV APPLICATIONS

3.1. EV and HEV configuration based on power converters
3.2. Classification of converters –unidirectional and bidirectional
3.3. Principle of step down operation
3.4. Boost and Buck- Boost converters
3.5. Principle of Step-Up operation

4. DC-AC INVERTER & MOTORS FOR EV AND HEVS

4.1. DC-AC Converters
4.2. Principle of operation of half bridge DC-AC inverter (R load, R-L load)
4.3. Single phase Bridge DC-AC inverter with R load, R-L load
4.4. Electric Machines used in EVs and HEVs,

5. BATTERIES

5.1. Overview of batteries
5.2. Battery Parameters,
5.3. types of batteries
5.4. Battery Charging,
5.5. alternative novel energy sources-
  5.5.1. solar photovoltaic cells,
  5.5.2. fuel cells,
  5.5.3. super capacitors,
  5.5.4. flywheels
5.6. Regenerative braking in EVs

REFERENCES:

1. A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishing House, New Delhi (Ed. 2018)
2. Fuhs, A. E. Hybrid Vehicles and the Future of Personal Transportation, CRC Press,
3. Gianfranco, *Electric and Hybrid Vehicles:* Power Sources, Models, Sustainability, Infrastructure And The Market, Pistoia Consultant, Rome, Italy,
4. Ehsani, M. *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press
5. Husain, I. *Electric and Hybrid Electric Vehicles*, CRC Press
6. Chan C. C. and K. T. Chau, *Modern Electric Vehicle Technology*, Oxford Science Publication,
7. Lechner G. and H. Naunheimer, *Automotive Transmissions: Fundamentals, Selection,Design and Application*, Springer
8. Rashid, M. H. *Power Electronics: Circuits, Devices and Applications*, 3rd edition, Pearson,
9. Moorthi, V. R. *Power Electronics: Devices, Circuits and Industrial Applications*, Oxford University Press
10. Krishnan, R. *Electric motor drives: modelling, analysis, and control*, Prentice Hall
11. Krause, O. P.; C. Wasynczuk, S. D. Sudhoff, *Analysis of electric machinery*, IEEE Press

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FUNDAMENTALS OF POWER ELECTRONICS LAB.

Course Code	EE 4006
Course Title	Fundamentals of Power Electronics Lab.
Number of Credits	1(L-0, T-0, P-2)
Prerequisites	None
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 the proper functioning of power electronic devices.

COURSE OUTCOME

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.

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 and holding 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.

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ELECTRIC POWER TRANSMISSION AND DISTRIBUTION LAB.

Course Code	EE 4007
Course Title	Electric Power Transmission and Distribution Lab.
Number of Credits	1(L-0, T-0, P-2)
Prerequisites	None
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 the proper functioning of the electrical transmission and distribution systems.

COURSE OUTCOME

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.

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 Rajsthan.
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 Maharastra 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 electric power.
d. Collect information on:
   (i) AC Distribution System adjacent to your institution.
   (ii) Draw a layout diagram of 11KV/400 V substation in your campus / adjacent substation.

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INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING LAB.

Course Code	EE 40081
Course Title	Industrial Instrumentation and Condition Monitoring Lab.
Number of Credits	1(L-0, T-0, P-2)
Prerequisites	None
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.

- Use instrumentation equipment for condition monitoring control.

COURSE OUTCOME

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 instruments used for measuring electrical and non-electrical quantities.
b) Select relevant transducers/sensors for various applications.
c) Use relevant instruments for measuring non-electrical quantities.
d) Check the signal conditioning and telemetry system for their proper functioning.

PRACTICALS:

1. Identify different switches used in instrumentation system.
2. Measure linear displacement by L.V.D.T.
3. Measure the strain with the help of strain gauge
4. Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge.
5. Use Thermocouple to control the temperature of a furnace/machine.
6. Measure pressure using pressure sensor kit.
7. Measure angular speed using stroboscope and tachometer.
8. Measure the flow using flow meter.
9. Use op-amp as inverter, non-inverting mode, adder, differentiator and integrator.
10. Convert digital data into analog data by using analog to digital converters and analog data into digital data by digital to analog converter.
11. Visit to testing centre of electrical testing lab for tan delta and diagnostic tests and determine polarization index
12. Prepare a Report on various tools and equipment used for condition monitoring of electrical machines

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ILLUMINATION PRACTICES LAB.

Course Code	EE 40082
Course Title	Illumination Practices Lab.
Number of Credits	1(L-0, T-0, P-2)
Prerequisites	None
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.

- Design illumination schemes and associated electrification of buildings.

PRACTICALS:

1. Conduct illumination level assessment in workplace using lux meter.
2. Fit the given lamp in the selected mounting
3. Interpret the polar curves of the given type of lamp and verify it using the lux meter.
4. Measure the illumination output of different lamps (Incandescent, Fluorescent, CFL,
5. LED, HPSV, HPMV) and compare it with their wattage.
6. Measure illumination level with and without reflectors used in the various Luminaries.
7. Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp.
8. Build a single lamp control by single switch
9. Build a single lamp control by two switches
10. Build a single lamp control circuit for two-point method
11. Build a lamp control circuit for three-point method
12. Build a lamp control circuit for four-point method.

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ELECTRICAL ESTIMATION AND CONTRACTING LAB.

Course Code	EE 40091
Course Title	Electrical Estimation and Contracting Lab.
Number of Credits	1(L-0, T-0, P-2)
Prerequisites	None
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.

- Design electrical installation with costing for tendering.

COURSE OUTCOME

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.

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

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ELECTRIC VEHICLES LAB.

Course Code	:	EE 40092
Course Title	:	Electric Vehicles 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 vehicles

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 salient features of Hybrid electric vehicles.
b) Interpret the Dynamics of hybrid and Electric vehicles
c) Maintain the DC-DC converters in EV applications.
d) Maintain the DC-AC converters in EV applications
e) Select the batteries for EV applications.

PRACTICALS:

1. Develop block diagram of Electric vehicle and identify parts
2. Case study- Compare minimum four vehicles for economic and environmental analysis
3. Develop schematic diagram of hybrid electric vehicle and identify the components fluorescent lamp.
4. Prepare report on Plug in Electric vehicle by visiting a charging station
5. Inspect and install inverter of given lead acid battery
6. Prepare a report on batteries used from market survey
7. Collect specifications of converters and inverters used for Electric vehicles a single lamp control by two switches
8. Diagnose, repair and maintain battery used in electric vehicle
9. Prepare test procedure for equipment used in Electric vehicle
10. List safety procedures and schedule for handling HEVs and EVs.

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INDUCTION, SYNCRONOUS AND SPECIAL ELECTRICAL MACHINES LAB.

Course Code	EE 4010
Course Title	Induction, Synchronous and Special Electrical machines Lab.
Number of Credits	1(L-0, T-0, P-2)
Prerequisites	None
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 Induction, Synchronous and FHP Machines used in different applications.

COURSE OUTCOME

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.

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

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ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

Course Code	EE 4222(Same in All Branches of Engg.)
Course Title	Essence of Indian Knowledge and Tradition
Number of Credits	0(L-2,T-0, P-0)
Prerequisites	None
Course Category	AU

COURSE CONTENTS:

Basic Structure of Indian Knowledge System:

(i)वेद,

(ii)उऩवेद (आयुवेद,धनुवेद,गन्धवेद,स्थाऩत्यआदद)

(iii)वेदथाथांग (शिक्था, कलऩ, ननरुत, व्थाकरण, ज्योनतषछथांद),

(iv)उऩथाइग (धर्मशथास्त्र, र्ीर्थाथांसथा, तुरथाण, तकशरथास्त्र)

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

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. V. Sivarama Krishna, " Cultural Heritage of India- Course Material", Bhartiya Vidya Bhavan, Mumbai, fifth Edition, 2014.
2. Swami Jitatmanand, " Modern Physics and Vedant", Bhartiya Vidya Bhavan.
3. Fritz of Capra, " The wave of Life".
4. Fritz of Capra, " Tao of Physics".
5. V N Jha, " Tarka sangraha of Annam Bhatta, International" Cinmay Foundation, Velliarnad, Amakuam.
6. R N Jha, " Science of Consciousness Psychotheraphy and Yoga Practices" Vidya nidhi Prakasham, Delhi, 2016.

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