GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN
JODHPUR

SEMESTER SCHEME-2020-21

(SESSION 2021-2022 & ONWARDS)

TEACHING AND EXAMINATION SCHEME AND SYLLABUS

ELECTRICAL ENGINEERING

(EE)

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Curriculum Development Cell
Board of Technical Education, Rajasthan
W-6 Residency Road,
Jodhpur

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA **III SEMESTER (ELECTRICAL ENGINEERING) (EE)**
SESSION 2021-2022 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs	PR	Hrs.	CT	TU/ Assi	PR(S)		
PC	EE 3001	Introduction to Electric Generation Systems	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 3002	Electrical Circuits	3	1	0	4	60	3	–	–	20	20	–	100	4
PC	EE 3003	Electrical and Electronic Measurements	2	1	0	3	60	3	–	–	20	20	–	100	3
PC	EE 3004	Electric Motors and Transformers	2	1	0	3	60	3	–	–	20	20	–	100	3
PC	EE 3005	Renewable Energy Power Plants	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 3006	Introduction t o Electric Generation Systems Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	EE 3007	Electrical Circuits Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	EE 3008	Electrical and Electronic Measurements Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	EE 3009	Electric Motors and Transformers Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	EE 3010	Renewable Energy Power Plants Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
SI	EE3011	Summer internship -1(4 weeks after II Sem.)	–	–	–	–	–	–	100	–	–	–	–	100	2
VS	+EE 3333	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**13**	**3**	**14**	**30**	**300**		**300**		**100**	**100**	**400**	**1200**	**25**
													Grand Total :	**1200**	**25**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +EE 3333 is same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
FOR DIPLOMA **IV SEMESTER (ELECTRICAL ENGINEERING) (EE)**
(SEMESTER SCHEME-2020-21)
SESSION 2021-2022 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs	CT	TU/Assi	PR(S)		
PC	EE 4001	Fundamentals of Power Electronics	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 4002	Electric Power Transmission and Distribution	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 4003	Induction, Synchronous and Special Electrical Machines	2	1	0	3	60	3	–	–	20	20	–	100	3
PE	EE 4004	**Programme Elective-I** EE 40041- Industrial Instrumentation and Condition Monitoring EE 40042- Illumination Practices	3	0	0	3	60	3	–	–	20	20	–	100	3
PE	EE 4005	**Programme Elective-II** EE 40051- Electrical Estimation and Contracting EE 40052- Electric Vehicles	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 4006	Fundamentals of Power Electronics Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	EE 4007	Electric Power Transmission and Distribution Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	EE 4008	**Programme Elective I Lab**. EE 40081- Industrial Instrumentation and Condition Monitoring Lab EE 40082- Illumination Practices Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	EE 4009	**Programme Elective II Lab.** EE 40091- Electrical Estimation and Contracting Lab EE 40092- Electric Vehicles Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	EE 4010	Induction, Synchronous and Special Electrical Machines Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PR	EE 4011	Minor Project	0	0	4	4	--	--	40	--	--	--	60	100	2
AU	+EE 4222	Essence of Indian Knowledge and Tradition	2	0	0	2	--	--	--	--	--	--	--	--	**0**
VS	+EE 4444	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**16**	**1**	**18**	**35**	**300**		**240**		**100**	**100**	**460**	**1200**	**24**
													Grand Total :	**1200**	**24**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +EE 4222 and +EE 4444 are same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

Note:Students will go for 6 Weeks Summer Internship in the Summer Vacations after Fourth Semester. The assessment of the Summer Internship will be done in Fifth Semester

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
(SEMESTER SCHEME-2020-21)
FOR DIPLOMA **V SEMESTER (ELECTRICAL ENGINEERING) (EE)**
SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU/Assi	PR(S)		
PC	EE 5001	Microcontroller Applications	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 5002	Energy Conservation and Audit	3	0	0	3	60	3	–	–	20	20	–	100	3
OE	+EE 5100	**Open Elective-I** +EE 51001- Economic Policies in India +EE 51002- Engineering Economics & Accountancy	3	0	0	3	60	3	–	–	20	20	–	100	3
PE	EE 5003	**Programme Elective III** EE50031- Switchgear and Protection EE50032- Electrical Testing and Commissioning	3	0	0	3	60	3	–	–	20	20	–	100	3
PE	EE 5004	**Programme Elective IV** EE50041- Electric Traction EE50042- Industrial Drives	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 5005	Microcontroller Applications Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PC	EE 5006	Energy Conservation and Audit Lab.	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	EE 5007	**Programme Elective III Lab.** EE50071- Switchgear and Protection Lab EE50072- Electrical Testing and Commissioning Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PE	EE 5008	**Programme Elective IV Lab** EE50081- Electric Traction Lab EE50082- Industrial Drives. Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
SI	EE 5009	SummerInternship-II (6 weeks after IVSem)	0	0	0	0	–	–	100	–	–	–	–	100	3
PR	EE 5010	Major Project	0	0	2	2	–	–	–	–	–	–	–	–	--
VS	+EE 5555	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**15**	**0**	**14**	**29**	**300**		**260**		**100**	**100**	**340**	**1100**	**24**
													Grand Total :	**1100**	**24**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +EE 51001, +EE 51002 and +EE 5555 are same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning

Note:Major Project will be continued and Assesed in VI Semester

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION RAJASTHAN, JODHPUR
TEACHING AND EXAMINATION SCHEME
FOR DIPLOMA **VI SEMESTER (ELECTRICAL ENGINEERING) (EE)**
(SEMESTER SCHEME-2020-21)
SESSION 2022-2023 & ONWARDS

Subject Category	Subject Code	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks	Credits
			Hours per week				End Semester Exam				Internal Assessment				
			L	T	P	Tot	TH	Hrs	PR	Hrs	CT	TU/Assi	PR(S)		
HS	+EE 6111	Entrepreneurship and Start-ups	3	1	0	4	60	3	–	–	20	20	–	100	4
OE	+EE 6200	**Open Elective-II** +EE 62001- Project Management +EE 62002- Renewable Energy Technologies	3	0	0	3	60	3	–	–	20	20	–	100	3
OE	+EE 6300	**Open Elective-III** +EE 63001- Product Design +EE 63002- Disaster Management	3	0	0	3	60	3	–	–	20	20	–	100	3
AU	+EE 6333	Indian Constitution	2	0	0	2	–	–	–	–	–	–	–	–	0
PC	EE 6001	Building Electrification	3	0	0	3	60	3	–	–	20	20	–	100	3
PC	EE 6002	Building Electrification Lab	0	0	2	2	–	–	40	3	–	–	60	100	1
PR	EE 6003	Major Project	--	--	6	6	--	--	40	--	--	--	60	100	4
SE	EE 6004	Seminar	1	0	0	1	–	–	–	–	–	–	100	100	1
VS	+EE 6666	Anandam (Joy of Giving)	--	--	1	1	--	--	--	--	--	--	100	100	2
		Students Centered Activities	0	0	3	3	--	--	--	--	--	--	--	--	--
		Total	**15**	**1**	**12**	**28**	**240**		**80**		**80**	**80**	**320**	**800**	**21**
													Grand Total :	**800**	**21**

1. L : Lecture
2. T : Tutorial
3. P : Practical
4. TH : Marks for End Semester Exam for Theory
5. PR : Marks for End Semester Exam for Practical
6. CT : Marks for class tests (Internal Assessment)
7. TU/Assi : Marks for tutorials/Assignment (Internal Assessment)
8. PR(S) : Marks for practical and viva (Internal Assessment)

1. +EE 6111, +EE 62001, +EE 62002, + EE 63001, +EE 63002, +EE 6333 and +EE 6666 are same in all branches of Engineering

Student Centered Activities will be graded as A, B, C & D on the basis of attendance and interest of the student in learning.

GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

III SEMESTER

(SESSION 2021-2022 & ONWARDS)

INTRODUCTION TO ELECTRIC GENERATION SYSTEMS

Course Code	EE 3001
Course Title	Introduction to Electric Generation Systems
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 efficient operation of various electric power generating plants.

COURSE OUTCOMES

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

a) Maintain the optimised working of the thermal power plant.
b) Maintain the optimised working of large and micro hydro power plants.
c) Select the adequate mix of power generation based on economic operation.

COURSE CONTENTS

1. THERMAL POWER PLANTS: COAL, GAS / DIESEL AND NUCLEAR-BASED

1.1 Layout and working of a typical thermal power plant with steam turbines and electric generators.
1.2 Properties of conventional fuels used in the energy conversion.
1.3 Various fuels used in thermal power plants:
  1.3.1 Coal.
  1.3.2 Gas / Diesel.
  1.3.3 Nuclear fuels – fusion and fission action.
1.4 Safe Practices and working of various thermal power plants:
  1.4.1 Coal-based.
  1.4.2 Gas-based.
  1.4.3 Diesel-based.
  1.4.4 Nuclear-based.
1.5 Functions of the following types of thermal power plants and their major auxiliaries:
  1.5.1 Coal fired boilers: fire tube and water tube.
  1.5.2 Gas/Diesel based combustion engines.
1.6 Types of nuclear reactors.
1.7 Thermal power plants in India and Rajasthan.

2. LARGE AND MICRO-HYDRO POWER PLANTS

2.1 Energy conversion process of hydro power plant.
2.2 Classification of hydro power plant: High, medium and low head.
2.3 Construction and working of hydro turbines used in different types of hydro power plant;:
  2.3.1 High head – Pelton turbine.
  2.3.2 Medium head – Francis turbine.
  2.3.3 Low head – Kaplan turbine.
2.4 Safe practices for hydro power plants.
2.5 Different types of micro-hydro turbines for different heads.
2.6 Locations of these different types of large and micro-hydro power plants in India and Rajasthan.

3. ECONOMICS OF POWER GENERATION AND INTERCONNECTED POWER SYSTEM

3.1 Related terms:
  3.1.1 Connected load.
  3.1.2 Firm power.
  3.1.3 Cold reserve.
  3.1.4 Hot reserve.

3.1.5 Spinning reserve.
3.1.6 Cost of generation.
3.1.7 Average demand.
3.1.8 Maximum demand.
3.1.9 Demand factor.
3.1.10 Plant capacity factor..

3.2 Base load and peak load plants.
3.3 Choice of size and number of generator units.
3.4 Causes and Impact and reasons of Grid system fault: State grid, national grid.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Nag. P. K., "Power Plant Engineering", McGraw Hill, New Delhi, ISBN: 978-9339204044
2. Tanmoy Deb, "Electrical Power Generation", Khanna Publishing House, Delhi (Ed. 2018)
3. Gupta, B.R., "Generation of Electrical Energy", S. Chand& Co. New Delhi,
4. Rachel, Sthuthi; Earnest, Joshua **"** Wind Power Technologies", PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
5. Solanki, Chetan Singh, **"** Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning, New Delhi, ISBN: 9788120351110
6. Hau**,** Erich, Wind Turbines, Springer-Verlag, Berlin Heidelberg, Germany, ISBN:978-3-642-27150-2
7. Gipe, Paul, "Wind Energy Basics", Chelsea Green Publishing Co; ISBN: 978-1603580304
8. Wizelius, Tore; Earnest, Joshua **,"** Wind Power Plants and Project Development", PHI
9. Gupta, J.B. "A Course in Electrical Power**",** S. K Kataria and Sons, New Delhi. 2014,
10. Soni, Gupta, Bhatnagar," A Course in Electrical Power."Dhanpatrai and Sons System, S.Chand& Co. New Delhi, 2005, ISBN: 9788121924962

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ELECTRICAL CIRCUITS

Course Code	EE 3002
Course Title	Electrical Circuits
Number of Credits	4 (L-3, 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 electrical systems applying AC and DC circuit fundamentals.

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) Troubleshoot problems related to single phase A.C series circuits.
b) Troubleshoot problems related to single phase A.C parallel circuits.
c) Troubleshoot problems related to three phase circuits.
d) Use principles of circuit analysis to troubleshoot electric circuits.
e) Apply network theorems to troubleshoot electric circuits.

COURSE CONTENTS

1. SINLE PHASE A.C. SERIES and PARALLEL CIRCUITS

- 1.1 Generations of alternating voltages.
- 1.2 Phasor representation of sinusoidal quantities.
- 1.3 R, L, C circuit elements its voltage and current response.
- 1.4 R-L, R-C, R-L-C combination of A.C. series and parallel circuit.
  - 1.4.1 Impedance
  - 1.4.2 Reactance
  - 1.4.3 Impedance triangle
  - 1.4.4 Power factor
  - 1.4.5 Active power
  - 1.4.6 Reactive power
  - 1.4.7 Apparent power
  - 1.4.8 Power triangle
  - 1.4.9 Vector diagram
- 1.5 Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, R-L-C circuit.

2. **THREE PHASE CIRCUITS**

- 2.1 Phasor and complex representation of three phase supply.
- 2.2 Phase sequence and polarity.
- 2.3 Types of three-phase connections.
- 2.4 Phase and line quantities in three phase star and delta system.
- 2.5 Three phase power, active reactive and apparent power in star and delta system.

3. **NETWORK REDUCTION AND PRINCIPLES OF CIRCUIT ANALYSIS**

- 3.1 Source transformation.
- 3.2 Star / delta and delta/ star transformation.
- 3.3 Mesh Analysis.
- 3.4 Node Analysis.

4. NETWORK THEOREMS (With numericals)

- 4.1 Superposition theorem.
- 4.2 Thevenin's theorem.
- 4.3 Norton's theorem.

4.4 Maximum power transfer theorem.
4.5 Reciprocity theorem.

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Ashfaq Husain," Networks & Systems", Khanna Book Publishing, New Delhi.
2. Gupta, B.R; Singhal, Vandana;, " Fundamentals of Electrical Network", S.Chand and Co., New Delhi, ISBN : 978-81-219-2318-7
3. Saxena, S.B Lal; Dasgupta, K; "Fundamentals of Electrical Engineering", Cambridge University Press Pvt. Ltd., New Delhi, ISBN : 978-11-0746-435-3
4. Theraja, B. L. : Theraja, A. K;"A Text Book of Electrical Technology Vol-I", S. Chand & Co. Ramnagar, New Delhi, ISBN : 9788121924405
5. Sudhakar, A. ; Shyammohan, S. Palli; "Circuit and network", McGraw Hill Education, New Delhi, ISBN : 978-93-3921-960-4
6. Bell, David A., "Electric Circuits", Oxford University Press New Delhi, ISBN : 978-01-954-2524-6
7. Boylested, R.L., "Introductory circuit Analysis", Wheeler, New Delhi,ISBN: 978-00-231-3161-5
8. Mittle, V.N. ;Mittle, Arvind; "Basic Electrical Engineering", McGraw Hill Education, Noida, ISBN: 978-00-705-9357-2
9. Sivanandam, S.N, "Electric Circuit Analysis", Vikas Publishing House Pvt. Ltd, Noida, ISBN:978-81259-1364-1
10. Salivahanan, S.; Pravinkumar, S; "Circuit theory", Vikas Publishing House Pvt. Ltd, Noida; ISBN:978-93259-7418-0

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ELECTRICAL AND ELECTRONIC MEASUREMENTS

Course Code	EE 3003
Course Title	Electrical and Electronic Measurements
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.

- Use relevant measuring instrument in different electrical 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) Check the working of the electrical measuring instrument.
b) Use different types of measuring instruments for measuring voltage and current.
c) Use different types of measuring instruments for measuring electric power
d) Use different types of measuring instruments for measuring electric energy.
e) Use different types of electrical instruments for measuring various ranges of electrical parameters.

COURSE CONTENTS

1. FUNDEMANTELS OF MEASUREMENTS

1.1 Measurements: Significance, units, fundamental quantities and standards.
1.2 Classification of Instrument Systems:
  1.2.1 Null and deflection type instruments.
  1.2.2 Absolute and secondary instruments.
  1.2.3 Analog and digital instruments.
1.3 Types of errors.
1.4 Calibration: need and procedure.
1.5 Classification of measuring instruments:
  1.5.1 Indicating.
  1.5.2 Recording

2. MEASUREMENT OF VOLTAGE AND CURRENT

2.1 Analog meters: construction, working, salient features, merits and demerits of
  2.1.1 Permanent magnet moving coil (PMMC)
  2.1.2 Permanent magnet moving iron (PMMI) meter.
2.2 DC Ammeter: Basic, Multi range, Universal shunt.
2.3 DC Voltmeter: Basic, Multi-range, concept of loading effect and sensitivity.
2.4 AC Voltmeter: Rectifier type (half wave and full wave).
2.5 CT and PT: construction, working and application

3. MEASUREMENT OF ELECTRIC POWER

3.1 Dynamometer type wattmeter: Construction and working
3.2 Range: Multiplying factor and extension of range using CT and PT.
3.3 Errors and compensations.
3.4 Active and reactive power measurement: One, two and three wattmeter method.

4. MEASUREMENT OF ELECTRIC ENERGY

4.1 Single and three phase electronic energy meter: Constructional feature and working principle.
4.2 Errors and their compensations.

5. CIRCUIT PARAMETER MEASUREMENT, CRO AND OTHER METER

5.1 Measurement of resistance:
- 5.1.1 Low resistance: Kelvin's double bridge.
- 5.1.2 Medium resistance: Voltmeter and ammeter method.
- 5.1.3 High resistance: Megger and Ohm meter: Series and shunt.

5.2 Measurement of induction using Anderson bridge (no derivation and phasor diagram).

5.3 Measurement of capacitance using Schering bridge (no derivation and phasor diagram).

5.4 Other meters:
- 5.4.1 Earth tester.
- 5.4.2 Digital Multimeter.
- 5.4.3 L-C-R meter.
- 5.4.4 Phase sequence indicator.
- 5.4.5 Power factor meter (single phase and three phase dynamometer type).

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Theraja B. L., Theraja A. K., "A Text Book of Electrical Technology Vol-I"(Basic Electrical Engg.), S.Chand and Co. New Delhi, ISBN: 9788121924405
2. Mittle V. N., "Basic Electrical Engineering", McGraw-Hill New Delhi, ISBN : 978-0-07-0088572-5,
3. Edward Hughes," Electrical Technology", Pearson Education, New Delhi, ISBN-13: 978-0582405196
4. Rajput R.K., "Electrical and Electronic Measurement and Instrumentation", S.Chand and Co. New Delhi, ISBN : 9789385676017
5. Sawhney A.K., "Electrical and Electronics Measurements and Instrumentation.", DhanpaiRai and Sons,New Delhi, ISBN : 9780000279744
6. Suryanarayna N.V., "Electrical Measurements and Measuring Instruments", S.Chand and Co. New Delhi , ISBN :8121920116

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ELECTRIC MOTORS AND TRANSFORMERS

Course Code	EE 3004
Course Title	Electric Motors and Transformers
Number of Credits	3 (L-2, T-1, P-0)
Prerequisites	None
Course Category	PC

COURSE OBJECTIVES

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

- Maintain electric motors and transformers.

COURSE OUTCOMES

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

a) Maintain different types of DC generators.
b) Maintain different types of DC motors.
c) Maintain single phase transformer.
d) Maintain three phase transformers.
e) Maintain different types of special purpose transformers used in different applications.

COURSE CONTENTS

1 DG GENERATORS

1.1 Construction, parts, materials and their functions.
1.2 Principle of operation of DC generator: Fleming's right hand rule.
1.3 Schematic diagrams.
1.4 E.m.f. equation of generators.
1.5 Armature reaction.
1.6 Commutation.
1.7 Applications of DC generator.

2 D.C. MOTORS

2.1 Types of DC motors.
2.2 Fleming's left hand rule.
2.3 Principle of operation.
2.4 Back e.m.f. and its significance.
2.5 Voltage equation of DC motor.
2.6 Torque
  2.6.1 Armature torque.
  2.6.2 Shaft torque.
  2.6.3 BHP
2.7 Losses.
2.8 Efficiency.
2.9 Speed control of DC shunt and series motor:
  2.9.1 Flux
  2.9.2 Armature control

3 SINGLE PHASE TRANSFORMERS

3.1 Types of transformers: Shell type and core type.
3.2 Construction: Parts and functions.
3.3 Principle of operation.
3.4 EMF equation of transformer.
3.5 Voltage transformation ratio.
3.6 Significance of transformer ratings.

3.7 Transformer No-load and on-load phasor diagram.
3.8 Equivalent circuit of transformers: Equivalent resistance and reactance.
3.9 Voltage regulation and Efficiency:
3.9.1 OC/SC method.
3.10 All day efficiency.

4. **THREE PHASE TRANSFORMERS**
4.1 Bank of three single phase transformers.
4.2 Single unit of three phase transformer.
4.3 Distribution and power transformers.
4.4 Construction.
4.5 Criteria for selection of distribution transformer and power transformer.
4.6 Amorphous core type Distribution Transformer.
4.7 Need of parallel operation of three phase transformer.
4.8 Polarity tests on mutually inductive coils and single phase transformers.
4.9 Polarity test, Phasing out test on Three-phase transformer.

5. **SPECIAL PURPOSE TRANSFORMERS**
5.1 Concepts and working of
5.1.1 Single phase auto transformers.
5.1.2 Three phase auto transformers.
5.1.3 Instruments Transformers: Current transformer and Potential transformer.
5.1.4 Single phase welding transformer.
5.2 'K' factor of transformers.

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RENEWABLE ENERGY POWER PLANTS

Course Code	EE 3005
Course Title	Renewable Energy Power Plants
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 efficient operation of various types of renewable energy power plants.

COURSE OUTCOMES

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

a) Maintain the optimised working of solar PV and CS power plants.
b) Maintain the optimised working of large wind power plants
c) Maintain the optimised working of small wind turbines.
d) Maintain the optimised working of biomass-based power plants.

COURSE CONTENTS

1 SOLAR PV AND CONCENTRATED SOLAR POWER PLANTS

- 1.1 Solar Map of India.
- 1.2 Global solar power radiation.
- 1.3 Concentrated Solar Power (CSP) plants.
- 1.4 Construction and working of:
  - 1.4.1 Power Tower.
  - 1.4.2 Parabolic Trough.
  - 1.4.3 Parabolic Dish.
- 1.5 Solar Photovoltaic (PV) power plant:
  - 1.5.1 Components layout.
  - 1.5.2 Construction.
  - 1.5.3 Working.
- 1.6 Rooftop solar PV power system

2 LARGE WIND POWER PLANTS

- 2.1 Wind map of India.
- 2.2 Wind power density in watts per square meter.
- 2.3 Lift and drag principle.
- 2.4 Components, layout and working of.
  - 2.4.1 Geared type wind power plants
  - 2.4.2 Direct drive type wind power plants.
- 2.5 Constant speed Electric Generators:
  - 2.5.1 Squirrel Cage Induction Generators (SCIG).
  - 2.5.2 Wound Rotor induction Generators (WRIG).
- 2.6 Variable speed Electric generators:
  - 2.6.1 Doubly-fed induction generator (DFIG).
  - 2.6.2 Wound rotor synchronous generator (WRSG).
  - 2.6.3 Permanent magnet synchronous generator (PMSG).

3 SMALL WIND TURBINES

- 3.1 Components and working of
  - 3.1.1 Horizontal axis small wind turbine:
    - 3.1.1.1 Direct drive type.
    - 3.1.1.2 Geared type.

3.1.2 Vertical axis small wind turbine.
3.1.2.1 Direct drive
3.1.2.2 Geared drive
3.1.3 Types of towers
3.1.4 Installation of small wind turbines on
3.1.4.1 Roof tops.
3.1.4.2 Open fields.
3.1.5 Electric generators used in small wind power plants.

4 BIOMASS-BASED POWER PLANTS

4.1 Properties of solid fuel for biomass power plants:
4.1.1 Bagasse.
4.1.2 Wood chips.
4.1.3 Rice husk.
4.1.4 Municipal waste.
4.2 Properties of liquid and gaseous fuel for biomass power plants:
4.2.1 Jatropha
4.2.2 Bio-diesel
4.2.3 Gobar gas.
4.3 Layout of a Bio-chemical based (e.g. biogas) power plant.
4.4 Layout of a Thermo-chemical based (e.g. Municipal waste) power plant.
4.5 Layout of a Agro-Chemical based (e.g. bio-diesel) power plant.

5 Ocean Energy :

5.1 Introduction to ocean energy
5.2 Types of ocean energy
5.2.1 Open cycle
5.2.2 Closed cycle

REFERENCES /SUGGESTED LEARNING RESOURCES:

1. Deambi, Suneel: "From Sunlight to Electricity: a practical handbook on solar photovoltaic application"; TERI, New Delhi ISBN:9788179935736
2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd - Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
3. Rachel, Sthuthi; Earnest, Joshua "Wind Power Technologies", PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
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INTRODUCTION TO ELECTRIC GENERATION SYSTEMS LAB.

Course Code	EE 3006
Course Title	Introduction to Electric Generation Systems 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 efficient operation of various electric power generating plants.

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:

1. Maintain the optimised working of the thermal power plant.
2. Maintain the optimised working of large and micro hydro power plants.
3. Select the adequate mix of power generation based on economic operation.

PRACTICALS:

1. Identify the routine maintenance parts of the coal fired thermal power plant after watching a video programme
2. Identify the routine maintenance parts of the gas fired thermal power plant after watching a video programme
3. Assemble and dismantle a small diesel generator power plant.
4. Identify the routine maintenance parts of the nuclear fired thermal power plant after watching a video programme.
5. Identify the routine maintenance parts of the large hydro power plant after watching a video programme
6. Identify the routine maintenance parts of the micro hydro power plant after watching a video programme.
7. Assemble a micro hydro power plant and then dismantle it.

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ELECTRICAL CIRCUITS LAB.

Course Code	EE 3007
Course Title	Electrical Circuits 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 electric systems applying AC and DC circuits fundamentals.

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) Troubleshoot problems related to single phase A.C series circuits.
b) Troubleshoot problems related to single phase A.C parallel circuits.
c) Troubleshoot problems related to three phase circuits.
d) Use principles of circuit analysis to troubleshoot electric circuits.
e) Apply network theorems to troubleshoot electric circuits.

PRACTICALS:

1. Use dual trace oscilloscope to determine A.C voltage and current response in given R, L, C circuit.
2. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit. Draw phasor diagram.
3. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C series circuit. Draw phasor diagram.
4. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
5. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.
6. Use voltmeter, ammeter, wattmeter to determine current, p.f. , active, reactive and apparent power in R-C parallel A.C. circuit.
7. Use voltmeter, ammeter, wattmeter, p.f meter to determine current, p.f., active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.
8. Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor.
9. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for balanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
10. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for unbalanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
11. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying mesh analysis.
12. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying node analysis.
13. Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.
14. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin's theorem
15. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton's theorem
16. Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

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ELECTRICAL AND ELECTRONIC MEASUREMENTS LAB.

Course Code	EE 3008
Course Title	Electrical and Electronic Measurement 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.

- Use relevant measuring instrument in different electrical 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) Check the working of the electrical measuring instrument.
b) Use different types of measuring instruments for measuring voltage and current.
c) Use different types of measuring instruments for measuring electric power
d) Use different types of measuring instruments for measuring electric energy.
e) Use different types of electrical instruments for measuring electrical parameters of various ranges.

PRACTICALS:

1. Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.
2. Identify the components of PMMC and MI instruments.
3. Troubleshoot PMMC and MI instruments.
4. Measure AC and DC quantities in a working circuit.
5. Extend range of ammeter and voltmeter by using (i) shunt and multiplier (ii) CT and PT.
6. Use Clamp-on meter for measurement of AC/DC current, AC/DC voltage.
7. Use electro-dynamic watt-meter for measurement of power in a single phase circuit
8. Troubleshoot electrodynamic watt-meter for measurement of power in a single phase circuit
9. Use single wattmeter for measurement of active and reactive power of three phase balanced load.
10. Use two watt-meters for measuring active power of three-phase balanced load.
11. Calibrate single phase electronic energy meter by direct loading.
12. Troubleshoot single phase electronic energy meter.
13. Use digital multi-meter for measurement of AC/DC current, AC/DC voltage.
14. Use Kelvin's double bridge for measurement of low resistance.
15. Use voltmeter and ammeter method for measurement of medium resistance.
16. Use Megger for insulation resistance measurements.
17. Use earth tester for measurement of earth resistance.
18. Use Tri-vector meter for measuring kW, kVAr and kVA of a power line.

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ELECTRIC MOTORS AND TRANSFORMERS LAB.

Course Code	EE 3009
Course Title	Electric Motors and Transformers 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.

- Use electric motors and transformers.

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 different types of DC generators.
b) Maintain different types of DC motors.
c) Maintain single phase transformer.
d) Maintain three phase transformers.
e) Maintain different types of special purpose transformers used in different applications.

PRACTICALS:

1. Dismantle a DC machine.
2. Reverse the direction of rotation of the DC shunt motor.
3. Perform brake test on DC shunt motor.
4. Control the speed of DC shunt motor by different methods.
5. Control the speed of DC series motor by different methods.
6. Perform the brake test on DC series motor.
7. Check the functioning of single phase transformer.
8. Determine regulation and efficiency of single phase transformer by direct loading.
9. Perform open circuit and short circuit test on single phase transformer to determine equivalent circuit constants, voltage regulation and efficiency.
10. Perform parallel operation of two single phase transformers to determine the load current sharing.
11. Perform parallel operation of two single phase transformers and determine the apparent and real power load sharing.
12. Perform polarity test on a single phase transformer whose polarity markings are masked.
13. Perform phasing out test on a three phase transformer whose phase markings are masked.
14. Connect the auto-transformer in step-up and step-down modes noting the input/output readings.
15. Check the functioning of the CT, PT and isolation transformer.
16. Test the pulse transformer.

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RENEWABLE ENERGY POWER PLANTS LAB.

Course Code	EE 3010
Course Title	Renewable Energy Power Plants 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 efficient operation of various renewable energy power plants.

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 the optimised working of solar PV and CS power plants.
b) Maintain the optimised working of large wind power plants
c) Maintain the optimised working of small wind turbines.
d) Maintain the optimised working of biomass-based power plants.

PRACTICALS:

1. Dismantle the parabolic trough CSP plant.
2. Assemble the parabolic trough Concentrated Solar Power (CSP) plant.
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Assemble the solar PV plant to produce electric power.
6. Dismantle the solar PV plant.
7. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
8. Assemble a horizontal axis small wind turbine to produce electric power
9. Dismantle a horizontal axis small wind turbine.
10. Assemble a vertical axis small wind turbine to produce electric power
11. Dismantle a vertical axis small wind turbine.
12. Assemble a small biogas plant to generate electric power
13. Dismantle the biogas plant.

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

IV SEMESTER

(SESSION 2021-2022 & ONWARDS)

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:

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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.

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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
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8. Hughes E., 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
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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)उन्नवेद (आयुवेद,धनुवेद,गन्धवेद,स्थान्नत्यआदद)

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

(iv)उन्नथाइग (धर्मशथास्त्र, र्ीथर्थांसथा, नुरथाण, 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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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:

a) Interpret the salient features of various types of microcontrollers.
b) Interpret the salient features of architype of types microcontrollers IC 8051
c) Maintain the program features of the Microcontroller based application
d) Develop assembly language program
e) Develop programs to interface 8051 microcontrollers with LED/SWITCH

COURSE CONTENTS

1. INTRODUCTION TO MICROCONTROLLERS

1.1. Evolution of Microcontrollers
1.2. Block diagram of Microcomputer,
1.3. elements of Microcomputer,
1.4. types of buses
1.5. Von Neuman and Harward Architecture
1.6. Compare Microprocessor and Microcontrollers
1.7. Need of Microcontroller
1.8. Family of Microcontrollers and their specifications

2. ARCHITECTURE OF MICROCONTROLLER 8051

2.1. Block diagram of 8051,
2.2. function of each block
2.3. Pin diagram, function of each pin
2.4. Concept of Internal memory and External memory (RAM and ROM)
2.5. Internal RAM structure
2.6. Reset and clock circuit

3. 8051 INSTRUCTION SET AND PROGRAMS

3.1. Overview of 8051 instruction set
3.2. Various addressing modes
3.3. Classification of instructions
    3.3.1. Data transfer instructions
    3.3.2. Arithmetic instructions
    3.3.3. Logical instructions
    3.3.4. Branching instructions
    3.3.5. Bit manipulation instructions
    3.3.6. Stack, subroutine and interrupt related instructions

4. ASSEMBLY LANGUAGE PROGRAMMING

4.1. Software development steps
4.2. Software development tools like Editor, Assembler, Linker, Loader and Hex converters.
4.3. Role of various files created at various levels in running a Assembly program using simulators like RIDE or KEIL.
4.4. 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; MckinlayRoline 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

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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:

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

COURSE CONTENTS

1. ENERGY CONSERVATION BASICS

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

2. ENERGY CONSERVATION IN ELECTRICAL MACHINES

2.1. Need for energy conservation in induction motor and transformer.
2.2. Energy conservation techniques in induction motor by:
  2.2.1. Improving Power quality.
  2.2.2. Motor survey
  2.2.3. Matching motor with loading.
  2.2.4. Rewinding of motor.
  2.2.5. Replacement by energy efficient motor
  2.2.6. Periodic maintenance
2.3. Energy conservation techniques in Transformer.
  2.3.1. Loading sharing
  2.3.2. Parallel operation
  2.3.3. Isolating techniques.
  2.3.4. Replacement by energy efficient transformers.
  2.3.5. Periodic maintenance.
2.4. Energy Conservation Equipment:
  2.4.1. Soft starters,
  2.4.2. Automatic star delta convertor,
  2.4.3. Variable Frequency Drives,
  2.4.4. Automatic p. f. controller (APFC),
  2.4.5. Intelligent p. f.controller (IPFC)
2.5. Energy efficient motor; significant features, advantages, applications and limitations.

3. ENERGY CONSERVATION IN ELECTRICAL INSTALLATION SYSTEMS

3.1. Aggregated Technical and commercial losses (ATC);
3.2. Power system at state, regional, national and global level.
3.3. 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., Venkataseshaiah; 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

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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 estotheproblemsofunemployment,poverty,incomegeneration,industrializationfromdifferentperspec-tives
CO4	Abletoidentifytheproblemsandcapabletodecidetheapplicationforfuturedevelopment
CO5	Analyzeeconomicissuesandfindsolutionstocomplexeconomicproblemsandtakecor-recteconomicjudgment

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, Unemploy-ment, Inflation, income inequality, Blackmoney 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.

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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.Paresh Shah, ‘Basic Financial Accounting for Management’, Oxford University Press, NewDelhi, 2007.
5.Salvatore Dominick, ‘Managerial Economics in a global economy’. Thomson SouthWestern, 4th Edition, 2001.

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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:

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

COURSE CONTENTS:

1. BASICS OF PROTECTION

1.1. Necessity and functions of protective system.
1.2. Normal and abnormal conditions.
1.3. Types of faults and their causes.
1.4. Protection zones and backup protection

2. CIRCUIT INTERRUPTION DEVICES

2.1. Isolators-
  2.1.1. Vertical break,
  2.1.2. Horizontal break
  2.1.3. Pantograph type.
2.2. HRC fuses – Construction, working, characteristics and applications.
2.3. Arc formation process,
2.4. methods of arc extinction (High resistance and Low resistance),
2.5. Arc voltage, Recovery voltage, Re-striking voltage, RRRV.
2.6. Working, and applications of HT circuit breakers
  2.6.1. (Sulphur-hexa Fluoride (SF6),
  2.6.2. Vacuum circuit breaker).
2.7. Working and applications of L.T. circuit breaker
  2.7.1. Air circuit breakers (ACB),
  2.7.2. Miniature circuit breakers (MCB),
  2.7.3. Moulded case circuit breakers (MCCB)
  2.7.4. Earth leakage circuit breaker (ELCB).
2.8. Selection of LT and HT circuit breakers (ratings),
2.9. Selection of MCCB for motors.

3. PROTECTIVE RELAYS

3.1. Fundamental quality requirements
  3.1.1. Selectivity,
  3.1.2. Speed,
  3.1.3. Sensitivity,
  3.1.4. Reliability,
  3.1.5. 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

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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:

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

COURSE CONTENTS:

1. ELECTRICAL SAFETY AND INSULATION

1.1. Do's and don'ts regarding safety in domestic electrical appliances as well for substation/power station operators
1.2. Electrical safety in industry/power stations/ substations at the time of operation/ control/maintenance.
1.3. Fire detection alarm, fire-fighting equipments
1.4. Factors affecting life of insulating materials,
1.5. Measuring insulation resistance by different methods and to predict the condition of insulation
  1.5.1. Polarization,
  1.5.2. Dielectric absorption,
  1.5.3. Megger

2. INSTALLATION AND ERECTION

2.1. Concept of foundation for installation of machinery.
2.2. Requirements of foundation for static and rotating electrical machinery.
2.3. Concept of leveling and aligning
2.4. Procedure for leveling and aligning alignment of direct coupled drive,
2.5. effects of mis-alignment
2.6. Requirements of installation of pole mounted transformer

3. TESTING AND COMMISSIONING

3.1. Concept of testing,
3.2. Objectives of testing.
3.3. Roles of I.S.S. in testing of electrical equipment,
3.4. Methods of testing - Direct/Indirect/Regenerative testing.
3.5. Commissioning, Tests before Commissioning for transformer, induction motor, alternator
3.6. Testing of transformer as per I.S.1886- 1967 and I.S.2026- 1962
3.7. Testing of three-phase Induction motor as per I.S.325 - 1970.
3.8. Testing of single-phase induction motor as per I.S.990-1965.
3.9. Testing of synchronous machines as per ISS
3.10. 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

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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

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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:

a) Interpret the traction layout and its systems
b) Maintain the power supply arrangements.
c) Maintain the function of the overhead equipment for electric traction
d) Maintain the different components of the electric locomotive.
e) Maintain the traction motor and train lighting system
f) Maintain the signalling and supervisory control systems.

COURSE CONTENTS:

1. BASICS OF TRACTION

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

2. POWER SUPPLY ARRANGEMENTS

2.1. Constituents of supply system:-
  2.1.1. Substation: layout, list of equipment and their functions
  2.1.2. Feeding post: list of equipment and their functions
  2.1.3. Feeding and sectioning Arrangements
  2.1.4. Sectioning and paralleling post
  2.1.5. Sub sectioning and Paralleling post
  2.1.6. Sub sectioning post
  2.1.7. Elementary section
2.2. Major equipment at substation,
2.3. Protection system for traction transformer and 25 kV centenary construction

3. OVERHEAD EQUIPMENT

3.1. Different types of overhead equipments
3.2. Pentagonal OHE Centenary Construction
3.3. Different Types of Centenary according to speed Limit
3.4. Overhead system-
  3.4.1. Trolley collector,
  3.4.2. Bow collector,
  3.4.3. Pantograph Collector

4. ELECTRIC LOCOMOTIVE

4.1. Classification and Nomenclature of Electric Locomotive
4.2. Block diagram of AC locomotive
4.3. Power Circuit of AC Locomotive
4.4. Equipment (List and Function only) used in auxiliary circuit of AC Locomotive
4.5. 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, Utlization 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.

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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:

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

COURSE CONTENTS:

1. ELECTRIC DRIVES –(Basic idea)

1.1. Need of Electric Drives,
1.2. Functional Block diagrams of an electric drives.
1.3. DC Motors, Motor Rating
1.4. Series, Shunt and compound DC motors.
1.5. Universal motor
1.6. Permanent magnet motor
1.7. DC servo motor
1.8. Moving coil motor
1.9. Torque motor
1.10. Starting and Braking of DC Motors
1.11. Brushless DC Motors for servo applications.
1.12. Maintenance procedure.

2. AC MOTORS

2.1. Single phase AC Motors
  2.1.1. Resistance split phase motors
  2.1.2. Capacitor run motors
  2.1.3. Capacitor start motors
  2.1.4. Shaded pole motors
2.2. Three phase Induction Motors
  2.2.1. Squirrel cage Induction motor
  2.2.2. Slip ring Induction Motor
2.3. Starting methods of Induction Motor
2.4. Braking methods of Induction Motor
2.5. Maintenance procedure.

3. DC DRIVES

3.1. Single phase SCR Drives
  3.1.1. Half wave converter
  3.1.2. Full wave converter
  3.1.3. Semi converter
  3.1.4. Dual converter
3.2. Three Phase SCR Drives
  3.2.1. 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.

REFERENCES:

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

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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:

a) Interpret the salient features of various types of microcontrollers.
b) Interpret the salient features of architype of types microcontrollers IC 8051
c) Maintain the program features of the Microcontroller based application
d) Develop assembly language program
e) Develop program to interface 8051 microcontrollers with LED/SWITCH

PRACTICALS:

1. Interpret details of Hardware kit for Microcontroller and practice to write and execute programs.
2. Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use.
3. Develop and execute Assembly language programs using Arithmetic Instructions and demonstrate outcome for a given input data
4. Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input
5. 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
6. Develop and execute Assembly language program for addition/subtraction of 16 bit no/multibyte nos. and demonstrate outcome for a given input data
7. 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.
8. 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.
9. Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data.
10. Develop and execute Assembly language program for LED blinking/LED sequences using delay/timer mode.
11. Develop and execute Assembly language program to interface LED with microcontroller.

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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:

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

PRACTICALS:

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

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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:

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

PRACTICALS:

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

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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:

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

PRACTICALS:

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

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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:

a) Interpret the traction layout and its systems
b) Maintain the power supply arrangements.
c) Maintain the function of the overhead equipment for electric traction
d) Maintain the different components of the electric locomotive.
e) Maintain the traction motor and train lighting system
f) Maintain the signalling and supervisory control systems.

PRACTICALS:

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

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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:

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

PRACTICALS:

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

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GOVERNMENT OF RAJASTHAN

BOARD OF TECHNICAL EDUCATION RAJASTHAN JODHPUR

SEMESTER SCHEME-2020-21

VI SEMESTER

(SESSION 2021-2022 & ONWARDS)

ENTREPRENEURSHIP AND START-UPS

Course Code	EE 6111(Same in All Branches of Engg.)
Course Title	Entrepreneurship and Start-ups
Number of Credits	4 (L-3 ,T-1, P-0)
Prerequisites (Course code)	None
Course Category	HS

COURSE LEARNING OBJECTIVES:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with varioususes ofhuman resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship-its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

LEARNING OUTCOME:

Upon completion of the course, these student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. StrategicMarketing Planning
6. New Productor Service Development
7. Business Plan Creation

COURSE CONTENTS:

1. INTRODUCTION TO ENTREPRENEURSHIP AND START–UPS

- 1.1. Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- 1.2. Types of Business Structures,
- 1.3. Similarities / differences between entrepreneurs and managers.

2. BUSINESS IDEAS AND THEIR IMPLEMENTATION

- 2.1. Discovering ideas and visualizing the business
- 2.2. Activity map
- 2.3. Business Plan

3. IDEA TO START-UP

- 3.1. Market Analysis– Identifying the target market,
- 3.2. Competition evaluation and Strategy Development,
- 3.3. Marketing and accounting,
- 3.4. Risk analysis

4. MANAGEMENT

- 4.1. Company's Organization Structure,
- 4.2. Recruitment and management of talent.
- 4.3. Financial organization and management

5. FINANCING AND PROTECTION OF IDEAS

- 5.1. Financing methods available for start-ups in India
- 5.2. Communication of Ideas to potential investors– Investor Pitch
- 5.3. Patenting and Licenses

6. EXIT STRATEGIES FOR ENTREPRENEURS ,BANKRUPTCY, AND SUCCESSION AND HARVESTING STRATEGY

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN–978-0984999392
2.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN–978-0670921607
3.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN–978-0755388974
4.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Chris Tensen	Harvard business ISBN:978-142219602

SUGGESTEDSOFTWARE/LEARNINGWEBSITES:

a. https://www.fundable.com/learn/resources/guides/startup
b. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporatehstructure/
c .https://www.finder.com/small-business-finance-tips
d. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

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PROJECT MANAGEMENT

CourseCode	EE 62001(Same in All Branches of Engg.)
CourseTitle	Project Management
NumberofCredits	3(L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.

•To develop an understanding of key project management skills and strategies.

COURSE OUTCOMES

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

CO1	Understand the importance of projects and its phases.
CO2	Analyze projects from marketing, operational and financial perspectives.
CO3	Evaluate projects based on discount and non-discount methods.
CO4	Develop network diagrams for planning and execution of a given project.
CO5	Apply crashing procedures for time and cost optimization.

COURSE CONTENTS

1. **CONCEPT OF A PROJECT**:
   - 1.1. Classification of projects
   - 1.2. Importance of project management
   - 1.3. The project Life cycle
   - 1.4. Establishing project priorities (scope-cost-time)
   - 1.5. Project priority matrix
   - 1.6. Work break down structure.

2. **CAPITAL BUDGETING PROCESS:**
   - 2.1. Planning -Analysis-Selection-Financing-Implementation-Review.
   - 2.2. Generation and screening of project ideas
   - 2.3. Market and demand analysis
   - 2.4. Demand forecasting techniques.
   - 2.5. Market planning and marketing research process
   - 2.6. Technical analysis

3. **FINANCIAL ESTIMATES AND PROJECTIONS:**
   - 3.1. Cost of projects
   - 3.2. Means of financing
   - 3.3. Estimates of sales and production-cost of production
   - 3.4. Working capital requirement and its financing
   - 3.5. Profitability project , cash flow statement and balance sheet.
   - 3.6. Breakeven analysis.

4. **BASIC TECHNIQUES IN CAPITAL BUDGETING**:
   - 4.1. Non discounting and discounting methods
   - 4.2. pay-back period
   - 4.3. Accounting rate of return
   - 4.4. Net present value
   - 4.5. Benefit cost ratio
   - 4.6. Internal rate of return.
   - 4.7. Project risk.
   - 4.8. Social cost benefit analysis andeconomic rate of return.
   - 4.9. Non-financial justification of projects**.**

5. **PROJECT ADMINISTRATION**:
   - 5.1. Progress payments,
   - 5.2. Expenditure planning,

5.3. Project scheduling and network planning,
5.4. Use of Critical Path Method(CPM),
5.5. Schedule of payments and physical progress,
5.6. time-cost trade off.
5.7. Concepts and uses of PERT
5.8. Cost as a function of time,
5.9. Project Evaluation and Review Techniques
5.10. Cost mechanisms.
5.11. Determination of least cost duration.
5.12. Post project evaluation.
5.13. Introduction to various Project management softwares.

REFERENCE BOOKS

1.Project planning, analysis, selection, implementation and review –Prasannachandra–Tata McGraw Hill
2.Project Management – the Managerial Process– Clifford F. Gray & Erik W. Larson-McGrawHill
3.Project management- David I Cleland- Mcgraw Hill International Edition, 1999
4.Project Management– Gopala krishnan– Mcmillan India Ltd.
5.Project Management- Harry – Maylor – Peason Publication

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RENEWABLE ENERGY TECHNOLOGIES

Course Code	EE 62002(Same in All Branches of Engg.)
Course Title	Renewable Energy Technologies
Number of Credits	3 (L:3,T:0,P:0)
Prerequisites	NIL
Course Category	OE

COURSE LEARNING OBJECTIVES

•To understand present and future scenario of world energy use.
•To understand fundamentals of solar energy systems.
•To understand basics of wind energy.
•To understand bio energy and its usage in different ways.
•To identify different available non-conventional energy sources.

COURSE OUTCOMES

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

CO1	Understand present and future energy scenario of the world.
CO2	Understand various methods of solar energy harvesting.
CO3	Identify various wind energy systems.
CO4	Evaluate appropriate methods for Bio energy generations from various Bio wastes.
CO5	Identify suitable energy sources for a location.

COURSE CONTENTS

1. INTRODUCTION:

1.1. World Energy Use;
1.2. Reserves of Energy Resources;
1.3. Environmental Aspects OF Energy Utilisation;
1.4. Renewable Energy Scenario in India and around the World;
1.5. Potentials; Achievements/ Applications;
1.6. Economics of renewable energy systems.

2. SOLAR ENERGY:

2.1. Solar Radiation;
2.2. Measurements of Solar Radiation;
2.3. Flat Plate and Concentrating Collectors;
2.4. Solar direct Thermal Applications;
2.5. Solar thermal Power Generation
2.6. Fundamentals of Solar Photo Voltaic Conversion;
2.7. Solar Cells;
2.8. Solar PV Power Generation;
2.9. Solar PV Applications.

3. WIND ENERGY:

3.1. Wind Data and Energy Estimation;
3.2. Types of Wind Energy Systems;
3.3. Performance; Site Selection;
3.4. Details of Wind Turbine Generator;
3.5. Safety and Environmental Aspects.

4. BIO-ENERGY:

4.1. Bio mass direct combustion;
4.2. Bio mass gasifiers;
4.3. Bio gas plants;
4.4. Digesters;
4.5. Ethanol production;
4.6. Bio diesel;
4.7. Cogeneration;

4.8. Bio mass Applications.

5. OTHER RENEWABLE ENERGY SOURCES:

5.1. Tidal energy;
5.2. Wave Energy;
5.3. Open and Closed OTEC Cycles;
5.4. Small Hydro Geothermal Energy;
5.5. Hydrogen and Storage;
5.6. Fuel Cell Systems;
5.7. Hybrid Systems.

REFERENCE BOOKS

1. Non-Conventional Energy Sources, Rai. G. D., Khanna Publishers, New Delhi, 2011.
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN SponLtd.,UK,2 006.
3. Solar Energy, Sukhatme. S. P., Tata Mc Graw Hill Publishing CompanyLtd. ,New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, G N Tiwari and M K Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment A Policy Analysis for India ,NH Ravindranath, U K Rao, B Natarajan, P Monga, Tata McGraw Hill.
7. Energy and The Environment, R A Ristinen and J J Kraushaar, second edition, John Willey & Sons, New York, 2006.
8. Renewable Energy Resources, J W T widell and A D Weir, ELBS, 2006.

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PRODUCT DESIGN

CourseCode	EE 63001(Same in All Branches of Engg.)
CourseTitle	Product Design
NumberofCredits	3 (L:3,T:0,P:0)
Prerequisites	NIL
CourseCategory	OE

COURSE LEARNING OBJECTIVES

•To acquire the basic concepts of product design and development process
•To understand the engineering and scientific process in executing a design from concept to finished product
•To study the key reasons for design or redesign.

COURSE OUTCOMES

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

CO1	Understand the basic concepts of product design and development process.
CO2	Illustrate the methods to define thecustomer needs.
CO3	Describe an engineering design and development process.
CO4	Understand the intuitive and advanced methods used to develop and evaluate a concept.
CO5	Apply modelling and embodiment principles in product design and development process.

COURSE CONTENTS

1. DEFINITION OF A PRODUCT

1.1. Types of product;
1.2. Levels of product;
1.3. Product-market mix;
1.4. New prod-uct development (NPD) process;
1.5. Idea generation methods;
1.6. Creativity;
1.6.1. Creative attitude;
1.6.2. Creative design process;
1.7. Morpho logical analysis;
1.8. Analysis of inter-connected decision areas;
1.9. Brain storming.

2. PRODUCT LIFECYCLE;

2.1. The challenges of Product development;
2.2. Product analysis;
2.3. Product characteristics;
2.4. Economic considerations;
2.5. Production and Marketing aspects;
2.6. Characteristics of successful Product development;
2.7. Phases of a generic product development process;
2.8. Customer need identification;
2.9. Product development practices and industry-product strategies.

3. PRODUCT DESIGN

3.1. Design by evolution;
3.2. Design by innovation;
3.3. Design by imitation;
3.4. Factors affecting product design;
3.5. Standards of performance and environmental factors;
3.6. Decision making and iteration;
3.7. Morphology of design (different phases);
3.8. Role of aesthetics in design.

4. INTRODUCTION TO OPTIMIZATION IN DESIGN

4.1. Economic factors in design;
4.2. Design for safety and reliability;

4.3. Role of computers in design;
4.4. Modeling and Simulation;
4.5. The role of models in engineering design;
4.6. Mathematical modeling;
4.7. Similitude and scale models;
4.8. Concurrent design;
4.9. Six sigma and design for six sigma;
4.10. Introduction to optimization in design;
4.11. Economic factors and financial feasibility in design;
4.12. Design for manufacturing;
4.13. Rapid Proto typing (RP);
4.14. Application of RP in product design;
4.15. Product Development versus Design.

5. DESIGN OF SIMPLE PRODUCTS DEALING WITH VARIOUS ASPECTS OF PRODUCT DEVELOPMENT;

5.1. Design Starting from need till the manufacture of the product

REFERENCE BOOKS

1.Product Design and Development, Karl T.Ulrichand Steven D.Eppinger, TataMc Graw–Hill edition.
2.Engineering Design– George E. Dieter.
3.An Introduction to Engineering Design methods Vijay Gupta.
4.Merie Crawford: New Product management, McGraw-Hill Irwin.
5.Chitale A K and Gupta R C," Product Design and Manufacturing", Prentice Hall of India, 2005.
6.Kevin Otto and Kristin Wood, Product Design, Techniques in Reverse Engineering and New Product Development, Pears on education.

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DISASTER MANAGEMENT

Course Code	EE 63002(Same in All Branches of Engg.)
Course Title	Disaster Management
Number of Credits	3 (L: 3, T: 0 ,P :0)
Prerequisites	NIL
Course Category	OE

COURSE LEARNING OBJECTIVES

Following are the objectives of this course:

•To learn about various types of natural and man-made disasters.
•To know pre and post-disaster management for some of the disasters.
•To know about various information and organizations in disaster management in India.
•To get exposed to technological tools and their role in disaster management.

COURSE OUTCOMES:

1.1. After competing this course, student will be:
1.2. Acquainted with basic information on various types of disasters
1.3. Knowing the precautions and awareness regarding various disasters
1.4. Decide first action to be taken under various disasters
1.5. Familiarised with organization in India which are dealing with disasters
1.6. Able to select IT tools to help in disaster management

COURSE CONTENTS

1. UNDERSTANDING DISASTER

1.1. Understanding the Concepts and definitions of Disaster,
1.2. Hazard,
1.3. Vulnerability,
1.4. Risk,
1.5. Capacity–Disaster and Development,
1.6. Disaster management.

2. TYPES, TRENDS, CAUSES, CONSEQUENCES AND CONTROL OF DISASTERS

2.1. Geological Disasters (earth quakes, landslides, tsunami, mining);
2.2. Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hailstorms, avalanches, droughts, cold and heat waves)
2.3. Biological Disasters (epidemics, pest attacks, forest fire);
2.4. Technological Disasters (chemical, industrial, radiological, nuclear)
2.5. Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters)
2.6. Global Disaster Trends
2.7. Emerging Risks of Disasters
2.8. Climate Change and Urban Disasters.

3. DISASTER MANAGEMENT CYCLE AND FRAME WORK

3.1. Disaster Management Cycle
3.2. Paradigm Shift in Disaster Management.
3.3. Pre-Disaster
3.4. Risk Assessment and Analysis,
3.5. Risk Mapping,
3.6. Zonation and Microzonation,
3.7. Prevention and Mitigation of Disasters,
3.8. Early Warning System
  3.8.1. Preparedness,
  3.8.2. Capacity Development;
  3.8.3. Awareness.
3.9. During Disaster
  3.9.1. Evacuation
  3.9.2. Disaster Communication
  3.9.3. Search and Rescue
  3.9.4. Emergency Operation Centre

3.9.5. Incident Comm and System
3.9.6. Relief and Rehabilitation
3.10. Post-disaster
3.10.1. Damage and Needs Assessment,
3.10.2. Restoration of Critical Infra structure
3.10.3. Early Recovery Reconstruction and Redevelopment;
3.10.4. IDNDR, Yokohama Stretegy, Hyogo Frame-work of Action.

4. DISASTER MANAGEMENT IN INDIA

4.1. Disaster Profile of India
4.2. Mega Disasters of India and Lessons Learnt.
4.3. Disaster Management Act 2005
4.4. Institutional and Financial Mechanism,
4.5. National Policy on Disaster Management,
4.6. National Guidelines and Plans on Disaster Management;
4.7. Role of Government (local, state and national),
4.8. Non-Government and Inter Governmental Agencies

5. APPLICATIONS OF SCIENCE AND TECHNOLOGY FOR DISASTER MANAGEMENT

5.1. Geo informatics in Disaster Management (RS, GIS, GPS and RS).
5.2. Disaster Communication System (Early Warning and Its Dissemination).
5.3. Land Use Planning and Development Regulations,
5.4. Disaster Safe Designs and Constructions,
5.5. Structural and Non Structural Mitigation of Disasters
5.6. S & T Institutions for Disaster Management in India

REFERENCES

1.Publications of National Disaster Management Authority (NDMA) on Various Templates and Guide lines for Disaster Management
2.Bhandani, R. K., An over view on natural & man-made disasters and their reduction, CSIR, New Delhi
3.Srivastava, H. N., and Gupta G. D. , Management of Natural Disasters in developing countries, Daya Publishers, Delhi
4.Alexander, David, Natural Disasters, Kluwer Academic London
5.Ghosh, G .K. ,Disaster Management, APH Publishing Corporation
6.Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

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INDIAN CONSTITUTION

CourseCode	EE 6333(Same in All Branches of Engg.)
CourseTitle	Indian Constitution
NumberofCredits	0 (L:2,T:0;P:0)
Prerequisites(Coursecode)	None
CourseCategory	AU

COURSE CONTENT

1. THE CONSTITUTION –

1.1. Introduction
1.2. The History of the Making of the Indian Constitution
1.3. Preamble and the Basic Structure, and its interpretation
1.4. Fundamental Rights and Duties and their interpretation
1.5. State Policy Principles

2. UNION GOVERNMENT

2.1. Structure of the Indian Union
2.2. President– Role and Power
2.3. Prime Minister and Council of Ministers
2.4. Lok Sabha and Rajya Sabha

3. STATE GOVERNMENT

3.1. Governor– Role and Power
3.2. Chief Minister and Council of Ministers
3.3. State Secretariat

4. LOCAL ADMINISTRATION

4.1. District Administration
4.2. Municipal Corporation
4.3. Zila Panchayat

5. ELECTION COMMISSION

5.1. Role and Functioning
5.2. Chief Election Commissioner
5.3. State Election Commission

SUGGESTED LEARNING RESOURCES:

S.No.	Title of Book	Author	Publication
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L.Fadia	Sahitya Bhawan; New edition(2017)
3.	Introduction to the Constitution of India	D D Basu	Lexis Nexis; Twenty-Third 2018 edition

SUGGESTED SOFTWARE / LEARNING WEBSITES:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

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BUILDING ELECTRIFICATION

Course Code	:	EE 6001
Course Title	:	Building Electrification
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:

- Design electrical installation systems in building complexes.

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 accessories, wires, cables and wiring systems for electrification.
b) Design electrical wiring installation system for residential unit.
c) Design proper illumination scheme for residential unit.
d) Prepare wiring layouts on wiring board.
e) Locate and diagnose faults in electrical wiring installation.
f) Do proper earthing for building electrification.

COURSE CONTENTS:

1. WIRING TOOLS AND ACCESSORIES

1.1. Various tools required for wiring- screw drivers, pliers, Try square, saws, hacksaw, chisel, hammers, mallet, rawl punch, hand drill machine, portable drilling machine, files, plumb bob, line thread, electricians knife, test lamp, tester
1.2. Care & maintenance of tools.
1.3. BIS symbols, of following electrical accessories. (symbols only)
1.3.1. **Switch** – surface switch, flush switch, and pull switch, rotary switch, knife switch, pendent switch, Main-switch (ICDP, ICTP). Single pole, double pole, two-way, two-way centre off, intermediate, series parallel switch
1.3.2. **Holders-**Bayonet cap lamp holder, pendent holder, batten lamp holder, angle holder, bracket holder, tube light holder, screw type Edison and goliath Edison lamp holder, swivel lamp holder.
1.3.3. **Socket outlets and plugs-** two pin, three-pin, multi pin sockets, two-pin and three-pin plug.
1.3.4. **Others-** Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber. Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes. Modular accessories.

2. ELECTRICAL WIRES AND UNDERGROUND CABLES

2.1. Conductors: - wire, cable, bus bar, stranded conductor, cable, armoured cable, flexible cable, solid conductor, PVC wires, CTS wire, LC wire, FR (Fire retardant) wire,. Tools used for measurement of wire size, Wire jointing methods (In brief).
2.2. Cable insulation materials –vulcanized rubber (VIR), polyvinyl chloride (PVC), cross linked polythene (XLPE), impregnated paper (in brief).
2.3. Selection of suitable cable size and type from standard data (in brief).
2.4. Cable jointing methods (in brief).
2.5. Cable laying methods (in brief).

3. WIRING METHODS AND WIRING LAYOUT

3.1. Conduit wiring-
3.1.1. Types of conduit,
3.1.2. comparison between Metal and PVC conduit,
3.1.3. types of conduit wiring (Surface/Concealed).
3.1.4. Conduit wiring accessories,

3.2. Concept and drawing of following electrical circuits:
- 3.2.1. Simple light and fan circuits,
- 3.2.2. Stair case wiring,
- 3.2.3. Go-down wiring circuit,
- 3.2.4. Bedroom lighting circuit,
- 3.2.5. Corridor lighting circuit,

4. RESIDENTIAL BUILDING ELECTRIFICATION

4.1. Domestic Dwellings/Residential Buildings:
4.2. Reading of Civil Engineering building drawing,
4.3. Interpretation of electrical installation plan and electrical diagrams,
4.4. Difference between residential and industrial load,
4.5. Load assessment: Selection of size of conductor, Selection of rating of main switch and protective switch gear.
4.6. Design,estimation and costing of a residential installation having maximum 5 KW load;
- 4.6.1. Sequence to be followed for preparing estimate;
- 4.6.2. Calculation of length of wire and other materials,
- 4.6.3. labour cost

4.7. Insulation resistance - between earth and conductors, between conductors,
4.8. Polarity test of single pole switches.
4.9. Testing of earth continuity path.
4.10. Residential building Service Connection- types Underground and overhead.

5. PROTECTION OF ELECTRICAL INSTALLATION

5.1. Fuse in electric circuit: Concept and operation
5.2. Types of fuses –Re-wirable, cartridge fuses (HRC and LRC), Fuse material Selection of fuse.
5.3. Miniature circuit Breaker (MCB)- Concept and Principle,
5.4. Earth Leakage Circuit Breaker (ELCB)-. Concept and Principle
5.5. System and equipment earthing and its requirements, Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current,
5.6. Measurement of earth resistance using earth tester,
5.7. Methods of earthing as per IS 3043: 1987 (in brief):-
- 5.7.1. Driven pipe,
- 5.7.2. pipe and plate earthing,
- 5.7.3. modern methods of earthing,

6. ILLUMINATION IN RESIDENTIAL INSTALLATION

6.1. Concept of Luminous flux, Luminous intensity, Lumen, luminous efficiency- values for different luminaries.
6.2. Factors affecting the illumination.
6.3. Different types of lighting arrangements,
6.4. Luminous flux of different types of light sources,

REFERENCES:

1. Raina, K.B. and S.K.Bhattacharya, Electrical Design Estimating and Costing, New Age International Ltd., New Delhi, ISBN 978-81-224-0363-3
2. Allagappan,N. S.Ekambarram, Electrical Estimating and Costing, New Delhi, ISBN-13: 9780074624784
3. Singh, Surjit, Electrical Estimating and Costing, DhanpatRai and Co. New Delhi, ISBN: 1234567150995
4. Gupta, J B: A Course in Electrical Installation Estimating and Costing, S K Kataria and Sons,New Delhi, ISBN:978-93-5014-279-0
5. Bureau of Indian Standard, IS: 732-1989, Code of practice for electrical wiring installation
6. Bureau of Indian Standard, SP 30 National Electrical Code 2010
7. Bureau of Indian Standard, SP 72 National Lighting Codes 2010
8. E-REFERENCES:-
   - http://nptel.ac.in/courses/108108076/1 , assessed on 18th January 2016
   - http://www.electrical4u.com, assessed on 18th January 2016
   - https://www.youtube.com/watch?v=A9KSGAnjo2U, assessed on 18th January 2016
   - http://www.electricaltechnology.org/2015/09, assessed on 30 Jan 2016
   - www.slideshare.net/bawaparam/made-by-paramassesed on 30 Jan2016
   - www.electricaltechnology.org/2013/09/electrical-wiring.htmlassessed on 16 March2016.

BUILDING ELECTRIFICATION LAB.

Course Code	:	EE 6002
Course Title	:	Building Electrification 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:

- Design electrical installation systems in building complexes.

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 accessories, wires, cables and wiring systems for electrification.
b) Design electrical wiring installation system for residential unit.
c) Design proper illumination scheme for residential unit.
d) Prepare wiring layouts on wiring board.
e) Locate and diagnose faults in electrical wiring installation.
f) Do proper earthing for building electrification.

PRACTICALS:

1. Prepare series testing board.
2. Select the electric wire using measuring and testing instruments for particular applications.
3. Identify cables of different current ratings.
4. Prepare wiring installation on a board showing control of one lamp, one fan and one socket from one switch board in PVC surface conduit wiring system.
5. Prepare wiring installation on a board.
6. Control one lamp from two different places using PVC surface conduit wiring system.
7. Prepare wiring installation on a board. Control one lamp from three different places using PVC surface conduit wiring system.
8. Prepare wiring installation on a board.
9. Perform go-down wiring for three blocks using PVC casing capping.
10. Design 2 BHK residential installation scheme and estimate the material required. And draw the details required for installation on A4 size sheet.
11. Test wiring installation using megger.

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