Savitribai Phule Pune University, Pune

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Third Year Electrical Engineering

(2019 course)

(w.e.f. 2021-22)

Savitribai Phule Pune University, Pune
Syllabus: Third Year (TE) Electrical Engineering (2019 course)
(w.e.f 2021-22)

SEMESTER-I

Course code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	SEM /PW /IN	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	SEM /PW /IN	Total
303141	Industrial and Technology Management	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303142	Power Electronics	3	4#	0	0	30	70	0	50	0	150	3	2	0	0	5
303143	Electrical Machines-II	3	2	0	0	30	70	25	25	0	150	3	1	0	0	4
303144	Electrical Installation Design and Condition Based Maintenance	3	4#	0	0	30	70	25	0	25	150	3	2	0	0	5
303145	Elective-I	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303146	Seminar	0	0	0	1	0	0	50	0	0	50	0	0	0	1	1
303147	Audit course-V	2*	0	0	0	0	0	0	0	0	0	GRADE: PP/NP				0
Total		**15**	**10**	**0**	**1**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**5**	**0**	**1**	**21**

303145: Elective-I	303147 : Audit Course-V
303145A : Advanced Microcontroller and Embedded System	303147A : Energy storage systems
303145B : Digital Signal Processing	303147B : Start-up & Disruptive innovation
303145C : Open Elective	

SEMESTER-II

Course code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	SEM /PW /IN	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	SEM /PW /IN	Total
303148	Power System-II	3	2	1	0	30	70	25	50	0	175	3	1	1	0	5
303149	Computer Aided Design of Electrical Machines	3	4#	0	0	30	70	50	0	25	175	3	2	0	0	5
303150	Control System Engineering	3	2$	1$	0	30	70	25	0	25	150	3	1	0	0	4
303151	Elective-II	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303152	Internship	0	0	0	4	0	0	100	0	0	100	0	0	0	4	4
303153	Audit Course VI	2*	0	0	0	0	0	0	0	0	0	GRADE: PP/NP				0
Total		12	8	2	4	120	280	200	50	50	700	12	4	1	4	21

303151: Elective-II	303153 : Audit Course-VI
303151A : IoT and its Applications in Electrical Engineering	303153A: Ethical Practices for Engineers
303151B : Electrical Mobility	303153B :Project Management
303 151C: Cybernetic Engineering	
303151D: Energy Management	

#Practical consists of Part A & part B. PART A; Regular experiments & part B; to bridge the gap between theory & actual industrial practices. For subject 303144; there will be auto cad drawing on Electrical installation, Electrical wiring, cabling etc. For 303149, Part A, Regular drawing by hand & part B same drawing by AutoCAD.
$ tutorial credit merged with Practical.
* Conduct over and above these lectures.

303141: Industrial and Technology Management

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Course Objectives: This course aims to

- Possess knowledge of types of business organizations.
- Explore the fundamentals of Industrial economics and Management.
- Understand the basic concepts of Technology management and Quality management.
- Analyze and differentiate between marketing management and financial management.
- Recognize the importance of Motivation, Group dynamics, Teamwork, leadership skill and entrepreneurship.
- Explain the fundamentals of Human Resource management.
- Identify the importance of Intellectual property rights and understand the concept of patents, copy rights and trademarks.
- Software programming to construct and use simple mathematical model.
- Ability to carry out basic manufacturing and testing procedure.

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

CO1	Differentiate between different types of business organizations and discuss the fundamentals of economics and management.
CO2	Explain the importance of technology management and quality management.
CO3	Explain the importance of IPR and role of Human Resource Management.
CO4	Understand the importance of Quality and its significance.
CO5	Describe the characteristics of marketing & its types and overview of financial Management.
CO6	Discuss the qualities of a good leader and road map to Entrepreneurship.

Unit 01 Introduction to Management and Economics — 07 hrs

A) Management: Meaning, scope, function, and importance of management. Difference between administration and management.

B) Industrial Economics: Definition of economics, Demand and Supply concept, Demand Analysis. Types of Demand, Determinants of Demand, Law of demand and supply, Elasticity of demand and supply, Law of Diminishing Marginal utility, Demand forecasting: Meaning and methods.

C) Business Organizations: Line organization, Staff organization and Functional Organization, (Project, Matrix, Committee Organization.)

D) Business Ownership and its Types: Types of business ownership, Sole proprietorship, Partnership (Act 1934), LLP (Limited Liability Partnership) (Act 2008). One person company, Joint Stock Company: Public Limited and Private Limited, Public Sector Undertaking (PSU).

Unit 02 Technology Management — 05 hrs

A) Technology Management: Definition of technology Management and its relation with society, development, application and its scope.

B) Classification of Technology Management: Classification of technology management at various levels- its importance on National Economy, Ethics in technology management, Critical factors in technology management.

Unit 03 Intellectual Property Rights (IPR) & Human Resource Management (HRM) — 06 hrs

A) Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different forms of IPR, Patents, Criteria for securing Patents. Patent format and structure, Copy rights and trademark (Descriptive treatment only).

B) Human Resource Management: Introduction, importance, scope, HR planning, Recruitment, selection, training and development, Performance management.

Unit 04	Quality Management	06 hrs

A) Quality Management: Definition of quality, continuous improvement, Types of quality, Quality of design, Seven QC Tools, Poka Yoke (Mistake Proofing), Quality circles, Kaizen. TQM, 5S (Case study of Toyota, descriptive treatment). Six-Sigma.
Basic software used for inventory management and quality management like Zoho inventory, Oracal, Netsuite, Vyapar, Quick book commerce.

B) Quality Management Standards (Introductory aspects only):- The ISO9001:2000 Quality Management System Standard-The ISO14001:2004, ISO26000, ISO 10004:2012, ISO 9001:2012 ISO 9001:2016, Environmental Management System Standard.

Unit 05	Marketing and Financial Management	06 hrs

A) **Marketing Management**: Meaning of Market, Marketing strategy, motives, market characteristics and its types, Perfect Competition, Monopoly, Monopolistic completion and Oligopoly. New product development, Product life cycle, Marketing and selling, methods of selling, marketing planning. Market survey and market research, Online Marketing (Digital Marketing).

B) **Financial Management:** Definition of financial management, cost Concept, Types of costs (Fixed, Variable, average, marginal, and total cost) and methods of costing price, capital. Debit, credit, Profit and loss statement, Balance sheet, Depreciation Analysis, causes and significance, methods of calculation of depreciation, Taxation system, and type of taxes.

Unit 06	Motivational Theory and Entrepreneurship	06 hrs

A) Motivation: Introduction to Motivation, theories of work motivation, Content Theories: Maslow's Hierarchy of Needs, Herzberg's Two factor theory, McClelland's Three Needs Theory, McGregor's Theory X and Theory Y.
Process Theories: Adam's Equity Theory, Vroom's Expectancy Theory, Taylor's Motivation Theory

B) Leadership: Importance of Leadership, Types of Leadership: Autocratic, Democratic and Laissez-Faire Leadership, qualities of good Leader. Group dynamics: Types and interactions of groups, stages of group dynamics: Norming, Storming, Forming, Performing and Adjourning.

C) Entrepreneurship: Importance and limitations of rational decision making, Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives, Case study on Small scale industries in India.

Test Books:

[T1]	O. P. Khanna, industrial engineering and management, Dhanpat Rai and sons, New Delhi.
[T2]	E. H. McGraw, S. J. Basic managerial skill for all.
[T3]	Tarek Khalil, Management of Technology Tata McGraw Hill Publication Pvt. Ltd.
[T4]	Prabuddha Ganguli Intellectual Property rights Tata McGraw Hill Publication Company
[T5]	Management Accounting and financial management by M. Y.Khan and P.K. Jain, Tata Mcgraw Hill-Tata-ISBN.

Reference Books:

[R1]	C. B. Mamoria and V. S. P. Rao- Personnel Management , Himalaya Publishing House, 30th Edition 2014.
[R2]	Harold Koonlz and OD'onnel–Management. Tata McGraw Hill Publication1980.
[R3]	Philip Kotler-Marketing Management. Pearson Edition 2008.
[R4]	Robert Heller, Managing Teams, Dorling Kindersley, London.
[R5]	Kelly John M, Total Quality Management, InfoTech Standard, Delhi.
[R6]	Joseph M. Juran, Juran's Quality Handbook TATA McGraw-Hill.
[R7]	Dale H. Bester field and Carol Bester field Total Quality Management Prentice Hall of India Pvt. Ltd.
[R8]	Shiv Sahai Singh [Editor] The Law of Intellectual Property rights.
[R9]	N. R. Subbaram, What Everyone Should Know About Patents, Pharma Book Syndicate, Hyderabad.
[R10]	Principles and Practices of Management –Dr. P.C. Shejwalkar, Dr. Anjali Ghanekar, Deepak

	Bhivpathki.
[R11]	Financial Management by I. M. Pandey, Vikas Publishing House Pvt. Ltd., Delhi Philip Kotler-Marketing Management.

Unit	Text Books	Reference Books
Unit 1	T1	R2,R10
Unit 2	T1, T2,T3	R5
Unit 3	-	R3,R5,R6
Unit 4	T5	R3, R11
Unit 5	T1	R1,R2
Unit 6	T4	R8

303142: Power Electronics

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**PR**	02	**ESE**	70 Marks
					PR	50 Marks

Prerequisite:

1. Knowledge of semiconductor material, basic electronics, diode, BJT, UJT, FET and its characteristics.
2. Working of Diode based rectifier, concept of RMS and average value
3. Use square notebooks for notes and plotting of waveforms.

Course Objectives: The course aims :-

To enable students to gain knowledge and understanding in the following aspects:

1. Fundamentals of power electronic devices and characteristics.
2. The concepts and operating principles of power electronics circuits.
3. Design procedures and techniques of power electronics systems.

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

CO1	Develop characteristics of different power electronic switching devices.
CO2	Reproduce working principle of power electronic converters for different types of loads.
CO3	Choose the appropriate converter for different applications.

Unit 01	**Power Semi-Conductor Devices**	**06 hrs**

Construction, Static and dynamic Characteristics, specifications/rating of SCR , Triggering Circuits (R, R-C, UJT), Commutation Circuits (class C & D), Protection (over voltage, over current, and Thermal), Gate Turn Off (GTO) Thyristor (Construction, Working and Application), TRIAC- four mode operation, triggering of TRIAC using DIAC, Application-light dimmer.

Unit 02	**Transistor based Devices and DC-DC converter**	**06 hrs**

Transistor based Devices: MOSFET & IGBT- Construction, working, Static and Dynamic Characteristics

DC-DC converter: Principle of operation of chopper, classification on the basis of operating quadrants (A, B, C, D, E), Control techniques: CLC, TRC, PWM and FM Techniques. Analysis of Step-up Chopper and Numerical with RLE load. Buck Boost Chopper (Descriptive Treatment), Applications- Chargers for Battery operated vehicles.

Unit 03	**Single Phase AC-DC Converter**	**06 hrs**

Single phase Converter: Fully controlled converter, Half controlled converter (Semi- converter)- Operation of all converters with R & RL load, derivation of Average and RMS output voltage, power factor, THD, TUF. Numerical based on output voltage and current calculations, Single phase dual converter (Descriptive treatment only), Application-Speed control of DC motor.

Unit 04	**Three Phase Converter and AC Voltage Regulator**	**06 hrs**

Three phase converters: Fully controlled converter, Half controlled converter (Semi converter)- Operation of all converters with R, RL load, derivation of Average and RMS output voltage. Numerical based on output voltage and current calculations.

AC voltage regulator: Single phase AC Voltage regulator; operation with R and RL Load, derivation of Average and RMS output voltage. Concept of two stage AC voltage regulator (Descriptive treatment only).

Unit 05	**Single phase DC-AC Converter (Transistor based)**	**06 hrs**

Full bridge VSI, derivation of output voltage and current, Numerical, current source inverter with ideal switches and load commutated CSI, Voltage control techniques, Application- UPS.

Unit 06	**Three phase DC-AC Converter (Transistor based)**	**06 hrs**

Three phase VSI for 120^0 and 180^0 modes of operation and their comparison, PWM based VSI, voltage control and harmonic elimination techniques (Single Pulse Modulation, Multilevel Control), Multilevel Converter concept its classification (Neutral Point Clamped Converter, Flying Capacitor Converter, cascaded multilevel converter) and their comparison, Application- Speed control of 3 phase Induction motor.

Test Books:

[T1]	M. H. Rashid - Power Electronics 2nd Edition, Pearson publication.
[T2]	Ned Mohan, T.M. Undel and, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons.
[T3]	B.W. Williams: Power Electronics 2nd edition, John Wiley and sons.
[T4]	Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
[T5]	Dr. P.S. Bimbhra, Power Electronics, Third Edition, Khanna Publication.
[T6]	K. Hari Babu, Power Electronics, Scitech Publication.

Reference Books:

[R1]	Vedam Subramanyam - Power Electronics , New Age International , New Delhi
[R2]	Dubey, Donalda, Joshi, Sinha, Thyristorised Power controllers, Wiley Eastern New Delhi.
[R3]	M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill.
[R4]	Jai P. Agrawal, Power Electronics systems theory and design LPE, Pearson Education, Asia.
[R5]	L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
[R6]	J. Michael Jacob – Power Electronics Principal and Applications.
[R7]	M. H. Rashid - Power Electronics Handbook, Butterworth-Heinemann publication, 3 edition
[R8]	V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.

Online Resources:

[O1]	NPTEL Web course and video course on Power Electronics by Dr. B. G. Fernandis, IIT, Mumbai.

Unit	**Text Books**	**Reference Books**
Unit 1	T5, T6	R3, R8, O1
Unit 2	T4, T5, T6	R3, R5, R6, R9, O1
Unit 3	T1, T5	R3, O1
Unit 4	T5, T6	R1, R7, O1
Unit 5	T1, T2, T3	R3, O1
Unit 6	T1, T2, T3	R3, O1

List of Experiments

Part A:

Minimum 8 hardware experiments to be conducted

1. Static VI characteristic of SCR / GTO.
2. Static VI characteristic of TRIAC.
3. Study of Gate firing circuits of SCR (R, RC & UJT).
4. Single phase Half controlled converter with R and RL load.
5. Single phase fully controlled converter with R load.
6. Single Phase fully controlled converter with and without Free Wheeling diode with RL load.

7. Three phase AC-DC fully controlled bridge converter R and RL load.
8. Study of DC step down chopper.
9. Single phase A.C. voltage regulator with R and RL load.
10. Output and Transfer Characteristic of MOSFET and IGBT (Both).
11. Three phase voltage source inverter using 120^0 and 180^0mode
12. Study of three phase inverter (VSI).

Part B:

Any 8 experiments to be conducted (either hardware or simulation)

1. Fabrication of buck converter/inverter/ac voltage regulator. (compulsory)
2. Study of 1-ø bridge inverter SPWM.
3. Study of Forced commutation circuits of SCR (Class C and Class D).
4. Study and design of SMPS.
5. Study of PWM controls of a single-phase inverter.
6. Power Quality Analysis (Harmonic and PF measurement) at AC side of Single phase controlled Converter.
7. Power Quality Analysis (Harmonic and PF measurement) at AC side of Three phase controlled Converter.
8. Performance analysis of three phase diode clamped Multilevel inverter.
9. Performance analysis of three phase cascaded H-Bridge Multilevel inverter.
10. Study of three phase Active power filter.
11. Study of Standalone/ Grid connected converters for interfacing of renewable energy sources.
12. Industrial Visit to Power Electronics manufacturing unit/Renewable energy power plant.

Guidelines for Instructor's Manual:

- Title and circuit diagram of power electronic switching device and converter circuit.
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit.
- Procedure to carry out the experiment.

Guidelines for Student's Lab Journal

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit.
- Equipment along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations must be written on left side of the journal and aim, theory related to experiment and procedure must be written on right side.
- Analyze and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory conduction

- Each group in the lab should have not more than three students.
- All the students in the group must do the connections and perform the practical under the guidance of the staff member.
- Staff member must check the result of all the groups.

303143: Electrical Machines-II

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**PR**	01	**ESE**	70 Marks
					PR	25 Marks
					TW	25 Marks

Prerequisite:

- Magnetic circuits, Force on current carrying conductor placed in magnetic field, Fleming Right Hand & Left Hand Rule.
- Working principle and construction DC Machines, transformer & 3-ph induction motor.
- Phasor diagram and equivalent circuit of single phase transformer.

Course Objectives: The course aims to:

- Learn construction & working principle of three phase synchronous machines and 1-ph induction motors.
- Calculate voltage regulation of Alternator by different methods.
- Study the applications of different machines in industrial, commercial & social sectors.
- Determine the performance indices of AC series & single phase motors by experimentation.

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

CO1	Learn construction, working principle of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
CO2	Understand characteristics of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
CO3	Select the above machines in Power System, industrial, household & Military Engineering applications.
CO4	Testing of machines to evaluate the performance through experimentation.

Unit 01	**Three phase Synchronous machines.**	**06 hrs**

Three phase Synchronous machines:
Construction, rotating-field type and rotating-armature type, salient-pole and non-salient-pole type and their comparison. Excitation Methods.

Three phase Synchronous generator (cylindrical rotor type): Principle of operation. Emf equation and winding factors (No derivation), rating of generator. Generator on no-load and on balanced load. Armature reaction and its effect under different load power factors. Voltage drop due to armature resistance, leakage flux and synchronous reactance. Per phase equivalent circuit and Phasor diagram. Power - power angle relation.

Three phase Synchronous generator (salient pole type):
Armature reaction as per Blondel's two reaction theory for salient-pole machines, Direct-axis and quadrature-axis synchronous reactance's and their determination by slip test. Phasor diagram of salient-pole generator and calculation of voltage regulation.

Unit 02	**Voltage regulation of Three phase Synchronous generator**	**06 hrs**

Performance of open circuit and short circuit test on synchronous generator, determination of voltage regulation by emf, mmf, and Potier triangle methods. Determination of voltage regulation by direct loading. Short circuit ratio.

Parallel operation of 3-phase alternators:
Necessity, conditions, Load sharing between two alternators in parallel (Descriptive treatment only). Process of synchronizing alternator with infinite bus-bar by lamp method (one dark & two equally

bright lamp method) and by the use of synchroscope, Synchronizing current, power and torque (no numerical).

Unit 03	**Three phase synchronous motor**	**06 hrs**

Principle of operation. Methods of starting. Equivalent circuit, significance of torque angle, Losses, efficiency and Power flow chart. Operation of 3-phase Synchronous motor with constant load and variable excitation ('V' curves and 'inverted V' curves). Phenomenon of hunting and its remedies. Applications of 3-phase synchronous motors. Comparison of 3 phase synchronous motor with 3-phase induction motor.

Unit 04	**3-ph induction motor, Induction generator and special purpose motors**	**06 hrs**

Speed control of three phase induction motor by various methods (Stator side and rotor side controls). Action of 3-phase induction motor as induction generator, applications of induction generator. Introduction to Energy Efficient three phase Induction Motor and Super Conducting Generator.

Special Purpose Motors : Construction, principle of working, characteristics, ratings and applications of Brush less D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.).

Unit 05	**A.C. series motor**	**06 hrs**

Operation of D.C. series motor on a.c. supply, nature of torque developed, problems associated with AC. operation and remedies.

Compensated series motor: Compensating winding, conductively and inductively compensated motor. Approximate phasor diagram. Use of compoles for improving commutation. Ratings and applications of Compensated Series motors.

Universal motors: Ratings, performance and applications, comparison of their performance on A.C. and D.C. supply.

Unit 06	**Single phase induction motor**	**06 hrs**

Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory. Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of motor. Methods of self-starting. Types of single phase induction motors: Split-phase motors (Resistor split-phase motor, Capacitor-start motor, Capacitor start and capacitor run motor and permanent capacitor motor). Comparison of 1-phase induction motor with 3-phase induction motor.

Test Books:

[T1]	Nagrath and Kothari, Electrical Machines, 2nd Ed., Tata McGraw Hill.
[T2]	S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
[T3]	A.S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill
[T4]	P. S. Bimbhra, Electric Machinery, Khanna Publications.
[T5]	B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
[T6]	B. L Theraja –Electrical Technology, Vol II , S. Chand publication.
[T7]	V. K. Mehta and Rohit Mehta, Principles of Electrical Machines, S Chand Publication
[T8]	Krishna Reddy –Electrical Machines Vol.II and III, SCITECH publications.
[T9]	Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.
[T10]	M V Deshpande, Electrical Machines, Prentice Hall of India

Reference Books:

[R1]	M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS
[R2]	J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications
[R3]	Samarjit Ghosh, Electrical Machines, Pearson Publication.
[R4]	Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinery and Transformer, 3rd Edition, Oxford University Press.
[R5]	E G Janardanan, Special Electrical Machines, Prentice Hall of India.
[R6]	Suvarnsingh Kalsi Application of high Temperature super conductors to electric power equipment (Rotating Machines) Wiley publication.

Unit	Text Books	Reference Books
Unit 1	T1,T2,T6,T7,T9	R3
Unit 2	T4, T6,T7,T9	R2
Unit 3	T1,T4, T6,T7	R2,R4
Unit 4	T4, T6,T7,T9	R5,R6
Unit 5	T4,T6,T3	R1,R2
Unit 6	T2,T3, T6,T7,T9	R2,R3

Industrial Visit:

Compulsory visit to Synchronous Machines / Induction motor manufacturing company.

List of Experiments: To perform any eight experiments from the following list.

Compulsory experiments:

1. Determination of voltage regulation of cylindrical rotor alternator by a) EMF method b) MMF method.
2. Determination of voltage regulation of cylindrical rotor alternator by Potier method.
3. Determination of voltage regulation of salient pole alternator by slip test.
4. V and inverted V curve of synchronous motor at constant load.
5. Speed control of three phase induction motor by V/F method.

B) Optional experiments (any three)

1. Determination of voltage regulation of alternator by direct loading.
2. Load test on three phase synchronous motor.
3. Load test on Single -phase induction motor.
4. Load test on Single-phase series motor.
5. No load and blocked-rotor test on a single phase Capacitor-start induction motor and Determination of its equivalent circuit parameters.
6. Synchronization of three phase alternator by Lamp and Synchroscope methods.
7. Simulation of three phase induction motor on MATLAB to obtain its performance.
8. Speed control of three phase induction motor by rotor resistance control method.
9. Speed control of BLDC Motor.

Guidelines for Instructor's Manual:

Prepare 3/4 sets of standard experiments. It must contain title of the experiment. Also, Aim, Apparatus including name of machines with their specifications, rheostats, ammeter, voltmeter, wattmeter if used along with their ratings / ranges etc.

Theory: Brief theory explaining the experiment.

Circuit / connection diagram or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.

Procedure: Write down step by step procedure to perform the experiment.

Observation table:

Sample calculation: For obs. number ---

Result table:

Nature of graph:
Conclusion:
Questions / Answers: Write minimum 4 /5, questions / answers based on each experiment.
Theory part must be typed on A-4 good quality paper on single side. Put these pages of experiments / circuit diagram in plastic folder and provide it to a group of 4/5 students.

Guidelines for Student's Lab Journal

1. Students should write the journal in his own hand writing.
2. Circuit / Connection diagram or construction diagram must be drawn either manually using or using software. [Do not use Xerox copy of standard journal]
3. Hand writing must be neat and clean.
4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
6. Put one blank page in between two experiments. Prepare the parallelogram at the center of page and write experiment number, date and title of the experiment in separate line.
(Use black or blue ink pen for writing.)

Guidelines for Laboratory conduction

1. Check the whether the MCB / main switch is off.
2. Students should go through the name plates of machines.
3. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
4. Perform the experiment only in presence of teacher or Lab Assistant.
5. Do the calculations and get it checked from the teacher.
6. After completion of experiment, switch off the MCB / main switch.
7. Write the experiment in the journal and get it checked within week.

303144: Electrical Installation, Design and Condition Based Maintenance

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**PR**	02	**ESE**	70 Marks
					OR	25 Marks
					TW	25 Marks

Prerequisite:

Basic Electrical Engg, Power System 1, Electrical Machines I and Electrical Machines II.

Course Objectives: The course aims: -

1. To classify different types of distribution supply system and determine economics of distribution system.
2. To compare and classify various substations, bus-bars and Earthing systems.
3. To demonstrate the importance and necessity of maintenance.
4. To analyze and test different condition monitoring methods.
5. To carry out estimation and costing of internal wiring for residential and commercial installations.
6. To apply electrical safety procedures.

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

CO1	Classify different types of distribution supply system and determine economics of distribution system. compare and classify various substations, bus-bars and Earthing systems.
CO2	Demonstrate the importance and necessity of maintenance.
CO3	Analyse and test different condition monitoring methods.
CO4	Carry out estimation and costing of internal wiring for residential and commercial installations.
CO5	Apply electrical safety procedures.

Unit 01	**Economics of Distribution Systems:**	**06 hrs**

Classification of supply systems (State Only)
(i) DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ac supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems (For above mentioned systems) on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors (Uniform and Non Uniform Loading) (Numerical). Economics of power transmission: Economic choice of conductor (Kelvin's law) (Derivation and Numerical). Distribution Feeders: Design considerations of distribution feeders; radial and ring types of primary feeder's voltage levels, energy losses in feeders.

Unit 02	**Substation and Earthing**	**06 hrs**

Substation: Classification of substations, Various equipment used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.
Earthing: Necessity of Earthing, Types of Earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation Earthing grid as per IEEE standard 80-2013.

Unit 03	**Maintenance and Condition Monitoring**	**08 hrs**

Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned/preventive maintenance and condition based maintenance. Planned and preventive maintenance of transformer, Induction motor and Alternators. Insulation stressing factors,

Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipment. Advance tools and techniques of condition monitoring, Thermography. Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, on load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis. Hot Line Maintenance - Meaning and advantages, special types of non-conducting Materials used for tools for hot line maintenance.		
Unit 04	**Basics of Estimation and Costing**	**04 hrs**
Purpose of estimating and costing, qualities of good estimator, essential elements of estimating and costing, tender, guidelines for inviting tenders, quotation, price catalogue, labor rates, schedule of rates and estimating data (only theory),		
Unit 05	**Installation and estimation of distribution system**	**06 hrs**
Introduction cable sizing, Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numerical) installations and estimate for underground LT service lines.		
Unit 06	**Testing and Electrical Safety**	**06 hrs**
Understanding CAT Ratings & Using CAT rated Instrument, Electrical Installation Testing Procedures- Insulation resistance test between installation and earth, Insulation resistance test between conductors (use of GUARD Terminal in IR test & Application) (methods used for IR Testing) Testing of polarity, Testing of earth continuity paths (Applications of PAT Tester "Portable Appliance Tester" in commercial like hotels, hospital & Industry also) and Earth resistance test (methods for earth testing 2-pole, 3-pole new methods clamp on type where we can performs test in Live) Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area. *(Introduction to OSHA)*		
Test Books:		
[T1]	B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication.	
[T2]	S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.	
[T3]	S. L. Uppal - Electrical Power - Khanna Publishers Delhi.	
[T4]	Hand book of condition monitoring by B. K. N. Rao, Elsevier Advance Tech., Oxford (UK).	
[T5]	S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House.	
[T6]	B. V. S. Rao – Operation and Maintenance of Electrical Equipment – Asia Publication.	
[T7]	Hand book on Electrical Safety.	
Reference Books:		
[R1]	P.S. Pabla –Electric Power Distribution, 5th edition, Tata McGraw Hill.	
[R2]	S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi.	
[R3]	Surjit Singh, Electrical wiring, Estimation and Costing, Dhanpat Rai and company, New Delhi.	
[R4]	Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi	
[R5]	B.D. Arora-Electrical Wiring, Estimation and Costing, - New Heights, New Delhi.	
[R6]	M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.	
[R7]	S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication .	
[R8]	Power Equipment Maintenance and Testing (Power Engineering Book 32) by Paul Gill	

Unit	Text Books	Reference Books
Unit 1	T1, T3	R1, R7
Unit 2	T1, T2, T3	R1, R4, R6
Unit 3	T2, T4, T5, T6	R6, R7, R8
Unit 4	--	R2, R3, R4, R5
Unit 5	T1, T3	R2, R3, R4, R5
Unit 6	T7	R8

List of Experiments

Part-A: (Any Eight of the following)

1) Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.
2) Study of thermograph images and analysis based on these images.
3) Practice of Earthing and Measurement of Earth resistance of Campus premises by using 4 Pole, 3 Pole, new technology practicing in industry clamp on method.
4) Single Line diagram of 132 or 220 or 400 kV substation (based on actual field visit) Symbols, Plate or Pipe Earthing. (Drawing sheets 1 using AutoCAD or other CAD software)
5) Assignment on design of Earthing grid for 132/220 kV substation.
6) Design and estimation of light and power circuit of labs/industry.
7) Measurement of insulation resistance of motors and cables.
8) Precautions from Electric shock and method of shock treatment.
9) Using of Installation Multifunction Testers for RCD testing, Phase Sequence Indication, Insulation resistance measurement, Continuity testing.
10) Use REVIT / any BOQ (Bill of Quantity) estimation software for estimation and costing
11) Design and estimation of light and power circuit of residential wiring.

Part-B:(Any 4 out of these)

1) Estimation and costing for 11 kV feeders and substation. (voltage drop calculation, SLD, substation layout)
2. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (**Any one**). i) Three phase induction motor ii) Transformer iii) Power Cable
3. Trouble shooting of household equipment – Construction, working and troubleshooting of any two household Electrical equipment's (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults) (Here we perform Practical by using PAT Testers)
4) Design, Estimation and costing of Earthing pit and Earthing connection for computer lab, Electrical Machines Lab.
5) Wiring installation and maintenance of pump motor.
6) Activity: Interview of Electrical maintenance personnel/Technician/Electrician.
7) Activity: Safety awareness for housing societies/schools/Junior colleges.
8) Activity: Preparation of Tender notice and studying the Tender notices published in newspapers.
9) Any innovative activity related to EIDCBM syllabus.

Industrial Visit (if any): Visit to substation/ installation sites.

303145A: Elective-I: Advanced Microcontroller and Embedded System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

1. Knowledge of Number system and Basic logic components.
2. Programming basics of C language.
3. Advantage of Microcontroller over Microprocessor.

Course Objectives: The course aims to:

1. Help Students understand Architecture of PIC 18F458 microcontroller.
2. Create and enhance ability to write and Interpret Assembly and C language for PIC 18F458.
3. Make students understand procedure to interface peripherals with PIC 18F458 for various Applications.

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

CO1	Explain architecture of PIC 18F458 microcontroller, its instructions and the addressing modes.
CO2	Use Ports and timers for peripheral interfacing and delay generation.
CO3	Interface special and generate events using CCP module.
CO4	Effectively use interrupt structure in internal and External interrupt mode.
CO5	Effectively use ADC for parameter measurement and also understand LCD interfacing.
CO6	Use Serial Communication and various serial communication protocols.

Unit 01	**PIC Architecture and Embedded C**	**07 hrs**

Comparison of CISC and RISC Architectures, Data and Program memory organization, Program Counters, Stack pointer, Bank Select Register, Status register, Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations.

Unit 02	**Port and Timer 0 Programming**	**05 hrs**

I/O Ports and related SFRs, I/O port programming in C. PIC 18 Timer 0 Programing in C. Delay programming (with and without Timer0). LED Interfacing and its programming.

Unit 03	**CCP Module and its applications**	**06 hrs**

CCP module in PIC 18 microcontroller, Timers required for CCP Applications, Applications of CCP mode Generation of Square waveform using Compare mode of CCP module. Period measurement of unknown signal using Capture mode in CCP module, Speed control of DC motor using PWM mode of CCP module.

Unit 04	**Interrupt structure and its Programming**	**05 hrs**

Interrupt Programming, Programming of Timer0 interrupts, Programming of External interrupts INT0.

Unit 05	**ADC structure and LCD interfacing**	**07 hrs**

PIC ADC, Programming of ADC using interrupts, Measurement of temperature and Power. Using PIC microcontroller. Interfacing of LCD (16x2) in 4 bit mode.

Unit	**Serial Communication and its protocols**	**06 hrs**

06		
Serial Communication structure and its programming (Data transmit and Receive), Introduction to Communication protocols as SPI and MODE BUS		
Test Books:		
[T1]	PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.	
[T2]	Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.	
[T3]	Programming And Customizing the PIC Microcontroller by Myke Predko, TATA McGraw-Hill.	
[T4]	PIC microcontroller: An introduction to software and Hardware interfacing by Han-Way-Huang Thomson Delmar Learning.	
[T5]	Microcontroller Theory and Applications with PIC18F, M. Rafiquzzaman, John Wiley and Sons	
Reference Books:		
[R1]	PIC18F458 datasheet	
[R2]	MPLAB IDE user guides	
[R3]	MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 Microcontroller by John B. Peatman, Prentice Hall	

Unit	Text Books	Reference Books
Unit 1	T1,T2,T3,T4	R1
Unit 2	T1, T2,T3,T4,T5	R1,R2
Unit 3	T1,T4,T5	R1
Unit 4	T1,T2,T3,T4	R1
Unit 5	T1,T2,T3,T4	R1
Unit 6	T1,T2,T3,T4	R1,R3

303145B: Elective-I: Digital Signal Processing

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Knowledge of basic signals and systems

Course Objectives: The course aims:

1. To introduce discrete signals and systems.
2. To ability to analyse DT signals with Z transform, DTFT and DFT.
3. To introduce Digital filters and analyze the response.
4. To explore DSP Applications in electrical engineering.

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

CO1	Analyse discrete time signals and systems.
CO2	Construct frequency response of LTI system using Fourier Transform.
CO3	Design and realize IIR and FIR filters.
CO4	Apply concepts of DSP in applications of electrical engineering.

Unit 01	**Discrete time signal and system**	**06 hrs**

Analog, Discrete-time and Digital signals, Basic sequences and sequence operations, Discrete time systems, Properties of D. T. Systems and Classification, Linear Time Invariant Systems, impulse response, linear convolution and its properties, properties of LTI systems: stability, causality, Periodic Sampling, Sampling Theorem, Frequency Domain representation of sampling, reconstruction of a band limited Signal, A to D Conversion Process: Sampling, quantization and encoding.

Unit 02	**Z and Inverse Z transform**	**06 hrs**

Revision of Z-transform, Numerical of Z transform, Inverse Z transform using partial fraction and power series method, Linear constant coefficient difference equations, solution of difference equation, stability and causality using ROC of Z-transform.

Unit 03	**Discrete Time Fourier Transform**	**06 hrs**

Representation of Sequences by Fourier Transform, Symmetry properties of D. T., F. T. theorems: Linearity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, Frequency response analysis of first and second order system, steady state and transient response.

Unit 04	**Discrete Fourier Transform**	**06 hrs**

Sampling in frequency domain, The Discrete Fourier Transform, Relation with z transform Properties of DFT: Linearity, circular shift, duality, symmetry, Circular Convolution, Linear Convolution using DFT, Effective computation of DFT and FFT, DIT FFT, DIF FFT.

Unit 05	**Design of IIR filter**	**06 hrs**

Ideal frequency selective filters, Concept of filtering, specifications of filter, IIR filter design from continuous time filters: Characteristics of Butterworth and Chebyshev, impulse invariant and bilinear transformation techniques, Design examples (Butterworth low pass filter) , Basic structures for IIR Systems: direct form, cascade form

Unit 06	**Design of FIR Filter and DSP Applications**	**06 hrs**

A) Specifications of properties of commonly used windows, Design Examples using rectangular and hanning windows. Basic Structures for FIR Systems: direct form. Comparison of IIR and FIR Filters. B) Applications: Measurement of magnitude and phase of voltage, current, power, frequency and power factor correction, harmonic Analysis and measurement, applications to machine control, DSP based protective relaying.

Test Books:

[T1]	Proakis J., Manolakis D., "Digital signal processing", 3rd Edition, Prentice Hall, ISBN 81-203-0720-8.
[T2]	P. Ramesh Babu, "Digital Signal Processing", 4th Edition SciTech Publication.

[T3]	Dr. S. D. Apte, "Digital Signal Processing",2nd Edition Wiley India Pvt. Ltd ISBN: 97881-265-2142-5
[T4]	W. Rebizant, J. Szafran, A. Wiszniewski, "Digital Signal Processing in Power system Protection and Control", Springer 2011 ISBN 978-0-85729-801-0
Reference Books:	
[R1]	Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
[R2]	A.V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete Time Signal Processing", 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9
[R3]	Steven W. Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists",1st Edition Elsevier, ISBN: 9780750674447

Unit	Text Books	Reference Books
Unit 1	T1,T2	R1, R2, R3
Unit 2	T1,T2	R2, R3
Unit 3	T1,T2	R2, R3
Unit 4	T1,T2	R2, R3
Unit 5	T1,T2,T3	R1,R2,R3
Unit 6	T2, T4	R3

303146: Seminar

Teaching Scheme			Credits		Examination Scheme	
SEM	01	Hr/Week	**SEM**	01	**TW**	50 Marks

Course Objectives:

1. Gaining of actual knowledge (terminology, classification, methods and advanced trends)
2. Learning fundamental principles, generalization or theories.
3. Discussion and critical thinking about topics of current intellectual importance.
4. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to the course.

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

CO1	Relate with the current technologies and innovations in Electrical engineering.
CO2	Improve presentation and documentation skill
CO3	Apply theoretical knowledge to actual industrial applications and research activity.
CO4	Communicate effectively.

Seminar should be based on a detailed study of any topic related to the advance areas/applications of Electrical Engineering. Topic should be related to Electrical Engineering. However, it must not include contents of syllabus of Electrical Engineering. It is expected that the student should collect the information from journals, internet and reference books in consultation with his/her teacher/mentor, have rounds of discussion with him/her. The report submitted should reveal the student assimilation of the collected information. Mere compilation of information from the internet and any other resources is discouraged.

Format of the Seminar report should be as follows:

1. The report should be neatly typed on white paper. The typing shall be with normal spacing, Times New Roman (12 pt) font and on one side of the paper. (A-4 size).
2. Illustrations downloaded from internet are not acceptable.
3. The report should be submitted with front and back cover of card paper neatly cut and bound together with the text.
4. Front cover: This shall have the following details with Block Capitals
    a. Title of the topic.
    b. The name of the candidate with roll no. and Exam. Seat No. at the middle.
    c. Name of the guide with designation below the candidate's details.
    d. The name of the institute and year of submission on separate lines at the bottom.
5. Certificate from institute as per specimen, Acknowledgement and Contents.
6. The format of the text of the seminar report should be as follows
    I. The introduction should be followed by literature survey.
    II. The report of analytical or experimental work done, if any.
    III. The discussion and conclusions shall form the last part of the text.
    IV. They should be followed by nomenclature and symbols used.
    V. The Reference Books are to be given at the end.
7. The total number of typed pages, excluding cover shall from 20 to 25 only.
8. All the pages should be numbered.
9. Two spiral bound copies of the seminar report shall be submitted to the college.
10. Candidate shall present the seminar before the examiners.
11. The total duration of presentation and after-discussion should be about 30 minutes.

The assessment for the subject shall be based on:

1. Content. 2. Presentation 3. Report

Rubrics for assessment

	Does not meet criterion	Meets criterion somewhat	Meets criterion fully
Content			
Background/Intro is sufficient to understand how this project fits into larger field	0	1	2
Description of methodology is sufficient for audience to understand the procedure	0	1	2
Explanations are understandable/clear	0	1	2
Conclusions stated are supported to topic	0	1	2
References/Sources are cited correctly	0	1	2
Audience questions are answered honestly (i.e. no bluffing or guessing)	0	1	2
Presentation Quality			
Speaking is understandable/clear	0	1	2
Speaker can answer questions professionally	0	1	2
Speaker makes eye contact with audience	0	1	2
Speaker uses professional body language	0	1	2
Visuals/PPT are clear and readable	0	1	2
Visuals/PPT have appropriate amount of text, diagrams	0	1	2
Visuals/PPT are free of errors/typos	0	1	2
Report Writing			
Abstract is meaningful	0	1	2
Graphs/diagrams are labeled completely	0	1	2
References/Sources are cited correctly	0	1	2
At least one reference is from a journal	0	1	2
Grammar is correct	0	1	2
Spelling is correct	0	1	2
Report format is clear	0	1	2
Total	_____/40 (convert to 50)		

303147A: Audit Course V: Energy Storage System

Teaching Scheme			Credits		Examination Scheme	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP

Prerequisite:

Batteries, Inductor and Capacitor.

Course Objectives:

To elaborate various energy storage systems
To be familiar with various aspects such as hybridization, selection of storage system.

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

CO1	Explain and differentiate various types of energy storage for suitable applications
CO2	Understand battery recycling techniques

Unit 01 **Energy Storage Fundamentals** **12 hrs**

(A) Battery: Energy Density, Power Density, Cycle life, C-rate, State of Charge (SoC), State of Health (SoH), Depth of Discharge (DoD), Characteristic.
(B) Types of Batteries: Nickel Metal Hydrate, Nickel Cadmium, Lithium ion, Lithium Polymer, Flow Batteries (Vanadium, Zinc, Manganese)
(C) Super capacitor, Superconducting Magnetic Energy Storage, Compressed Air Energy Storage, Flywheel storage
(D) Hybridization of energy storage

Energy storage sizing, Selection of storage as per application

Unit 02 **Recent Trends in Storage** **12 hrs**

Solid state batteries, Aluminum air and Aluminum ion batteries, Lithium ion Capacitor, Advances in Thermal energy storage systems. Batteries recycling techniques and policies, Case studies.

Reference Books:

[R1]	Handbook of Energy Storage: Demand, Technologies, Integration Michael Sterner, Ingo Stadler.
[R2]	Energy Storage: Fundamentals, Materials and Applications, Robert Huggins.

Industrial Visit: Manufacturing industry of battery or Capacitor.

303147B: Start-up and Disruptive Innovations

Teaching Scheme			Credits		Examination Scheme	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP

Prerequisite:

Course Objectives:

To learn fundamentals related to Start-up and initiatives taken by government along with policies.
To understand Disruptive technologies.

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

CO1	Describe role of incubation for Startup and recent national policy.
CO2	Identify various types of Startups.
CO3	Explain impacts of disruptive innovation and Differentiate between disruptive innovation and disruptive technology

Unit 01 Start-up — 12 hrs

Startup Fundamentals

Startup: Stages of startup life cycle, business model, business plan, Business incubation, Startup financing life cycle, Funding options for startup, Market, Market Segments.

Entrepreneurship: Types of Entrepreneurship: Social, Rural, Women, Agri-preneurship. Factors affecting Entrepreneurship Growth

Government Initiatives and Policies

Initiatives taken by the government, Startup India Scheme, National Innovation and Startup Policy 2019, Approvals and other regulatory processes, Challenges faced by startups in India, Students Startup, Faculty Startup.

Types of Startups and Case Studies

Types of Startups: E-commerce Startups, EdTech Startups, FinTech Startups, Food and Beverages Startups, Health Care Startups, Block chain Startups etc.

Case study : Airbnb, Paytm, Byju, Zomato, Red bus, Ola, Razorpay

Unit 02 Disruptive Technologies — 12 hrs

Disruptive Innovation Fundamental

What is invention? What is innovation? Defining Disruptive Innovation, Sustaining Innovation, Disruptive Innovation Theory, Disruptive innovation model, Disruptive strategy, Impact of Disruptive Innovation, Requirements of Disruptive Innovation, Types of Disruptive Innovations.

Inventor vs. Entrepreneur vs. Manager: Schumpeter's Trumpeters

Schumpeter's "creative destruction"

Maslow's Hierarchy of Needs Revisited, Disrupting Brands, Disrupting Religion.

Disruptive Technologies

Agricultural Revolution, Scientific Revolution, Industrial Revolution, Digital Revolution

Disruptive Innovation Vs Disruptive Technology

IoT, AI, Cloud Computing, Digital Twin, CRISPR, Block chain, 3D printing, Advanced Energy Storage, Hyperloop, Autonomous Vehicles, Nano technology, Industrial Automation (Industry 4.0)

Reference Books:

[R1]	The $100 Startup : Reinvent the Way you Make a Living, Do What You Love and Create a New Future, Chris Guillebeau
[R2]	Creating a Successful Business Plan, Entrepreneur Magazine
[R3]	Thomas Kuhn and The Theory of Scientific Revolutions revisited, CRC Press
[R4]	P. Armstrong. Disruptive Technologies: Understand, Evaluate, Respond Kogan Page Publishers. (2017)
[R5]	Innovator's Solution: Creating and Sustaining Successful Growth – Clayton Christensen, 16 December 2013
[R6]	Digital Disruption: Unleashing the Next Wave of Innovation – James McQuivey, 26

	February 2013
Online Resources:	
[O1]	https://ipindia.gov.in/
[O2]	https://www.wipo.int/about-ip/en/
[O3]	https://www.weforum.org/agenda/2016/06/what-is-disruptive-innovation/

303148: Power System-II

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**TU**	01	**ESE**	70 Marks
Tutorial	01	Hr/Week/batch	**PR**	01	**PR**	50 Marks
					TW	25 Marks

Note: TW marks: 15 for Tutorial and 10 for continuous assessment of lab work

Prerequisite:

Power Generation Technology, Power System-I, Electrical machine I and II

Course Objectives:

1) Develop analytical ability for Power system.
2) Introduce concept of EHVAC and HVDC System.
3) Demonstrate different computational methods for solving problems of load flow.
4) Analyze the power system under symmetrical and Unsymmetrical fault conditions.

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

CO1	Solve problems involving modelling, design and performance evaluation of HVDC and EHVAC power transmission lines.
CO2	Calculate per unit values and develop Y bus for solution power flow equations in power transmission networks
CO3	Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.

Unit 01	**Performance of Transmission Lines**	**06 hrs**

Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, surge impedance loading, Line efficiency, Regulation and compensation, basic concepts. Numerical based on: ABCD constants of Long transmission line, Power flow.

Unit 02	**EHVAC Transmission**	**05 hrs**

Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, radio and television interference, reduction of interference, Numerical Based on Corona, Corona loss and power handling capacity.

Unit 03	**Per Unit System and Load Flow Analysis**	**07 hrs**

Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system. Numerical based on network reduction by using per unit system.

Load Flow Analysis: Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using bus incidence matrix method, Numerical based on Y bus Matrix, power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (polar method) Decoupled and Fast decoupled load flow (descriptive treatment only).

Unit 04	**Symmetrical Fault Analysis**	**06 hrs**

3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit-breakers and current limiting reactors and their location in power system (Descriptive treatment Only) Numerical

Based on symmetrical fault analysis.		
Unit 05	**Unsymmetrical Fault Analysis**	**07 hrs**
Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedance of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance. Numerical based on symmetrical components and unsymmetrical fault calculation.		
Unit 06	**HVDC Transmission**	**05 hrs**
Classification and components of HVDC system, advantages and limitations of HVDC transmission, comparison with HVAC system, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control, HVDC systems in India, recent trends in HVDC system.		

Test Books:

[T1]	I.J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.
[T2]	B R Gupta , "Power System Analysis and Design", S. Chand.
[T3]	Ashfaq Hussain, "Electrical Power Systems", CBS Publication 5th Edition.
[T4]	J. B. Gupta. "A course in power systems" S.K. Kataria Publications.
[T5]	P.S.R. Murthy, "Power System Analysis", B.S. Publications

Reference Books:

[R1]	H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.
[R2]	G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.
[R3]	M. E. El- Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.
[R4]	Rakash Das Begamudre, "Extra High voltage A.C. Transmission Engineering", New age publication.
[R5]	M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication.
[R6]	Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi.
[R7]	K. R. Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.
[R8]	Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.
[R9]	V. K. Chandana, Power Systems, Cyber tech Publications.
[R10]	P. Kundur, Power System Stability And Control, McGraw Hill

Online Resources:

[O1]	NPTEL Course on power system engineering:Debpriya Das https://nptel.ac.in/courses/108/105/108105104/
[O2]	NPTEL Course on power system analysis By Dr. A.K. Sinha https://nptel.ac.in/courses/108/105/108105067/
[O3]	NPTEL Course on power system analysis By Dr. Debpriya Das https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee72/

Unit	Text Books	Reference Books
Unit 1	T1, T4	R1, R2, R3, R10
Unit 2	T2	R3, R4
Unit 3	T1, T3, T4	R1, R2, R3, R6, R8, R10
Unit 4	T3, T4	R1, R2, R3, R6, R8, R9, R10
Unit 5	T3	R1, R2, R3, R6, R8
Unit 6	T2, T3, T4	R3, R7, R9, R10

Industrial Visit:

Compulsory visit to EHV-AC substation/ HVDC substation

List of Tutorial: **(Minimum 10 Tutorial should be conducted) (Maintain Record in file or separate notebook)**

(Such types of numerical also in INSEM and ENDSEM examination)

1) ABCD parameters of long transmission line--(3 numerical)
2) power flow using generalized constant--(3 numerical)
3) power flow and losses in EHVAC transmission line for specified ratings. --(3 numerical)
4) Determination of Y-bus for three, four and five bus system--(3 numerical)
5) Load flow analysis using NR method for three bus system (1 numerical)
6) Calculation of symmetrical fault current and determine value of current limiting reactor suitable for given circuit breaker rating (2 numerical)
7) Determination of line/phase current, voltage and power calculation using symmetrical component. (4 numerical)
8) Calculation of unsymmetrical fault current (4 numerical)
9) Write a report on different HVDC project in India / world wide
10) Solve challenging questions related to syllabus (5 numerical)
11) Receiving end Power Circle diagram (1 Numerical)

List of Experiments

List of Experiments (Compulsory experiments):

1. Measurement of ABCD parameters of a medium transmission line with magnitude and angle.
2. Measurement of ABCD parameters of a long transmission line with magnitude and angle.
3. Performance study of the effect of VAR compensation using capacitor bank on the transmission line.
4. Formulation and calculation of Y- bus matrix of a given system using software.
5. Static measurement of sub-transient reactance of a salient-pole alternator.
6. Measurement of sequence reactance of a synchronous machine (Negative and zero).

Any three experiments are to be performed out of following:

1. Plotting of receiving end circle diagram to evaluate the performance of medium transmission line.
2. Solution of a load flow problem using Newton-Raphson method using software.
3. Simulation of Symmetrical fault of single machine connected to infinite bus.
4. Simulation of Unsymmetrical fault of single machine connected to infinite bus.
5. Simulation of HVDC system.

Guidelines for Instructor's Manual:

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.

- Graph and Conclusions.
- Few questions related to the experiment.

Guidelines for Student's Lab Journal

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Laboratory conduction

There should be continuous assessment for the TW.

- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

303149: Computer Aided Design of Electrical Machines

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**TU**	00	**ESE**	70 Marks
Tutorial	00	Hr/Week/batch	**PR**	02	**OR**	25 Marks
					TW	50Marks

Prerequisite:

1. Knowledge of fundamentals of electrical engineering.
2. Knowledge of various materials used in electrical machines.
3. Knowledge of types, construction and working of transformer.
4. Knowledge of types, construction and working of three phase induction motor.

Course Objectives: The course aims to:-

1. Design of transformer based on specifications.
2. Determine performance based on the parameters of transformer.
3. Design of Induction motor based on specifications.
4. Determine performance based on the parameters of Induction motor.
5. Apply computer aided design techniques to transformer and induction motor design.

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

CO1	Summarize temperature rise, methods of cooling of transformer and consider IS 2026 in transformer design.
CO2	Design the overall dimensions of the transformer.
CO3	Analyze the performance parameters of transformer.
CO4	Design overall dimensions of three phase Induction motor
CO5	Analyze the performance parameters of three phase Induction motor.
CO6	Implement and develop computer aided design of transformer and induction motor.

Unit 01	**Transformer Design: Part 1**	**06 hrs**

Modes of heat dissipation. Heating and cooling curves. Calculations of heating and cooling time constants. Methods of cooling of transformer. Types and constructional features of core and windings used in transformer. Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator. Specifications of three phase transformers as per IS 2026 (Part I). Introduction to computer aided design

Unit 02	**Transformer Design: Part 2**	**06 hrs**

Output equation with usual notations, optimum design of transformer for minimum cost and loss. Design of core, estimation of overall dimensions of frame and windings of transformer. Design of tank with cooling tubes.

Unit 03	**Performance parameters of Transformer**	**06 hrs**

Estimation of resistance and leakage reactance of transformer. Estimation of no-load current, losses, efficiency and regulation of transformer. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Computer aided design of transformer, generalized flow chart for design of transformer.

Unit 04	**Three phase Induction Motor Design:Part1**	**06 hrs**

Specifications and constructional features. Types of ac windings. Specific electrical and magnetic loadings, ranges of specific loadings. Output equation with usual notations. Calculations for main dimensions, turns per phase and number of stator slots.

Unit 05	**Three phase Induction Motor Design:Part2**	**06 hrs**

Suitable combinations of stator and rotor slots. Selection of length of air gap, factors affecting length of air gap. Design of rotor slots, size of bars and end rings for cage rotor. Conductor size, turns and area of rotor slots for wound rotor.

Unit 06	**Performance parameters of Three Phase Induction motor**	**06 hrs**

Leakage flux and leakage reactance: Slot, tooth top, zig - zag, overhang. Leakage reactance calculation for three phase machines. MMF Calculation for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current, calculations of no-load current. Calculations of losses and efficiency. Computer aided design of induction motor, generalized flow chart for design of induction motor.

Test Books:

[T1]	M. G. Say–Theory and Performance and Design of A.C. Machines,3rd Edition, ELBS London.
[T2]	A.K. Sawhney–A Course in Electrical Machine Design, -Dhanpat Rai and sons New Delhi
[T3]	K. G. Upadhyay- Design of Electrical Machines, New age publication
[T4]	R. K. Agarwal–Principles of Electrical Machine Design, S. K. Katariya and sons.
[T5]	Indrajit Dasgupta –Design of Transformers–TMH

Reference Books:

[R1]	K. L. Narang, A Text Book of Electrical Engineering Drawings, Reprint Edition, Satya Prakashan, New Delhi.
[R2]	A Shanmuga sundaram,G. Gangadharan, R. Palani,-Electrical Machine Design Data Book,3rd Edition, 3rd Reprint 1988- Wiely Eastern Ltd.,- New Delhi
[R3]	Vishnu Murti, "Computer Aided Design for Electrical Machines", B. S. Publications.
[R4]	Bharat Heavy Electricals Limited, Transformers - TMH.

Unit	Text Books	Reference Books
Unit 1	T1,T2,T4,T5	R1,R2,R4
Unit 2	T1,T2,T4,T5	R1,R4
Unit 3	T2,T5	R3,R4
Unit 4	T1,T2,T3,T4	R1,R2,R3
Unit 5	T2	R3
Unit 6	T2	R3

Industrial Visit:

Industrial visit to a transformer and Induction motor manufacturing/repairing unit.

List of Experiments

1. Details and assembly of transformer with design report. (Sheet in CAD)
2. Details and layout of single layer three phase winding with design report. (Sheet in CAD)
3. Details and layout of double layer three phase winding with design report. (Sheet in CAD)
4. Details and layout of three phase mush winding with design report. (Sheet in CAD)
5. Assembly of three phase induction motor. (Sheet in CAD)
6. Use of Finite Element Analysis(FEA) software for analysis of electrical machines, the report should include:

a. Schematic diagram (Diagram/FEA model/Layout)
b. Current/Flux/Force/Heat distribution.
c. Analysis by variation of design parameters.

7. Report based on transformer manufacturing/repairing unit.
8. Report based on induction motor manufacturing/repairing unit.

Guidelines for Instructor's Manual:

Theinstructor'smanualshouldcontainfollowingrelatedtoeverydrawingsheet-

1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.

6. Few short questions related to design.
7. A3 size sheet to be used for CAD drawing.

Guidelines for Student's Lab Journal

TheStudent'sLabJournalshouldcontainfollowingrelatedtoeverydrawingsheet-

1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.
6. Few short questions related to design.
7. A3 size sheet to be used for CAD drawing.

Guidelines for Laboratory conduction

1. There should be continuous assessment for the Lab/TW
2. Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to design as per the problem statement.
3. Timely submission of design report and sheet.

303150: Control System Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**TU**	01	**ESE**	70 Marks
Tutorial	01	Hr/Week/batch	**PR**		**OR**	25 Marks
					TW	25 Marks

Prerequisite:

Laplace Transform, Ordinary differential equations.

Course Objectives: The course aims to:-

- To understand basic concepts of the classical control theory.
- To model physical systems mathematically.
- To analyze behavior of system in time and frequency domain.
- To design controller to meet desired specifications.

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

CO1	Construct mathematical model of Electrical and Mechanical system using differential equations and transfer function and develop analogy between Electrical and Mechanical systems.
CO2	Determine time response of systems for a given input and perform analysis of first and second order systems using time domain specifications.
CO3	Investigate closed loop stability of system in s-plane using Routh Hurwitz stability criteria and root locus.
CO4	Analyze the systems in frequency domain and investigate stability using Nyquist plot and Bode plot
CO5	Design PID controller for a given plant to meet desired time domain specifications.

Unit 01	**Basics of Control System**	**07 hrs**

Basic concepts of control system, classification of control systems, types of control system: feedback, tracking, regulator system, feed forward system, transfer function, concept of pole and zero, modeling of Electrical and Mechanical systems (Only series linear and rotary motion) using differential equations and transfer function , analogy between electrical and mechanical systems, block diagram algebra, signal flow graph, Mason's gain formula.

Unit 02	**Time domain analysis**	**06 hrs**

Concept of transient and steady state response, standard test signals: step, ramp, parabolic and impulse signal, type and order of control system, time response of first and second order systems to unit impulse, unit step input, time domain specifications of second order systems, derivation of time domain specifications for second-order under-damped system for unit step input, steady state error and static error coefficients.

Unit 03	**Stability analysis and Root Locus**	**05 hrs**

Concept of stability: BIBO, nature of system response for various locations of poles in S-plane. Routh's-Hurwitz criterion. Root Locus: Angle and magnitude condition, Basic properties of root locus. Construction of root locus, Stability analysis using root locus.

Unit 04	**Frequency domain analysis-I**	**06 hrs**

Introduction, Frequency domain specifications, correlation between time and frequency domain specifications, polar Plot, Nyquist plot, stability analysis using Nyquist plot.

Unit	**Frequency domain analysis-II**	**06 hrs**

05		
Introduction to Bode plot, Asymptotic approximation: sketching of Bode plot, stability analysis using Bode plot.		
Unit 06	**PID controllers and Control system components**	**06 hrs**
Basic concept of P, PI, PID controller, design specifications in time domain and frequency domain. design of PID controller by Root Locus, tuning of PID controllers using Ziegler-Nichol Methods Control System Components: Working principle and transfer function of Lag network, lead network, potentiometer, DC servo motors.		

Test Books:

[T1]	I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 6th edition, 2017.
[T2]	Katsuhiko Ogata, "Modern control system engineering", Prentice Hall, 2010.
[T3]	Nise N. S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011
[T4]	R. Anandanatrajan and P. Ramesh Babu, "Control Systems Engineering", Scitech Publication,3rd edition, 2011
[T5]	C. D. Johnson, "Process Control Instrumentation Technology, 8th edition, PHI Learning Pvt. Ltd., 2013

Reference Books:

[R1]	B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.
[R2]	Richard C Dorf and Robert H Bishop, "Modern control system", Pearson Education, 12th edition, 2011.
[R3]	D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005.
[R4]	B. Wayne Bequette, "Process Control: Modeling, Design and Simulation", PHI, 2003.

Unit	Text Books	Reference Books
Unit 1	T1,T2,T3	R1,R2
Unit 2	T1,T2,T3	R1,R3
Unit 3	T1,T2,T3	R2,R3
Unit 4	T1,T2,T3	R1,R3
Unit 5	T1,T2,T3	R1,R3
Unit 6	T1,T2,T5	R4

List of Tutorial:

Tutorial (Minimum ten tutorials should be conducted)

1. Reduce the given block diagram and determine overall transfer function.
2. Determine transfer function of the system represented by signal flow graph using Mason's gain formula.
3. Determine time domain specifications of given second order systems.
4. Determine static error constants and steady state error for the given systems.
5. Investigate closed loop stability of a given systems using Routh Hurwitz stability criterion.
6. Sketch the root locus of a given systems and comment on stability.
7. Sketch the polar plot of given systems.
8. Sketch the Nyquist plot of a given system, determine stability margins and comment on stability.
9. Sketch the Bode plot of a given systems, determine stability margins and comment on stability.
10. Determine the tuning parameters of PID controller using open loop step response and closed loop ultimate cycle methods of Ziegler and Nichol.
11. Design the PID controller for desired specifications using root locus approach.

List of Experiment

A) Minimum five experiments should be conducted.

1. Experimental determination of DC servo motor parameters for mathematical modeling and transfer function
2. Experimental study of time response characteristics of R-L-C second order system. Validate the results using software simulation.
3. Experimental determination of frequency response of Lead compensator.
4. Experimental determination of frequency response of Lag compensator.
5. PID control of level/ Temperature/speed control system.
6. Experimental determination of transfer function of any one physical systems (AC Servomotor/ Two Tank System/ Temperature control/ Level control)
7. Experimental analysis of D.C. Motor Position control System.

B) Minimum three experiments should be conducted (perform using software)

1. Stability analysis using a) Bode plot, b) Root locus and c) Nyquist plot.
2. Effect of P, PI and PID controllers on time response of second order system.
3. Analysis of closed loop DC position control system using PID controller.
4. Effect of addition of pole-zero on root locus of second order system.
5. Effect of addition of dominant and non-dominant poles on step response of second order system.
6. PID controller for speed/position control of DC servomotor.

Guidelines for Instructor's Manual:

Instructor's Manual should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram
- Basic MATLAB instructions for control system/ Simulink basics
- Observation table/ Expected simulation results
- Sample calculations for one/two reading
- Result table

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram/Simulink diagram/MATLAB program
- Observation table/ simulation results
- Sample calculations for one/two reading
- Result table, Conclusion
- Software program and result (if applicable)
- Few short questions related to the experiment.

Guidelines for Laboratory conduction

- Assessment must be based on understanding of theory, attentiveness during practical session.
- Assessment should be done how efficiently student is able to perform experiment/simulation and get the results. Understanding fundamentals and objective of experiment, timely submission of journal

303151A: Elective II: IoT and Its Applications in Electrical Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Basics of Electrical generation, transmission, distribution and utilization, Fundamentals of logic circuits, C, C+.

Course Objectives: The course aims to

1. Understand the architecture of Internet of Things
2. Evaluate the electrical systems for making them IoT enable
3. Assess the automated processes and retrofit it for enhancement is user accessibility.

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

CO1	Build circuits for signal acquisition and conditioning
CO2	Experiment with sensors and actuators and choose the right sensor for application
CO3	Determine the performance of IoT based automated process
CO4	Design and develop IoT based applications

Unit 01	**Introduction to IoT**	**06 hrs**

Fundamental components of IoT, Evolution of Connected Devices, Basic Architecture of IoT, ISO and IEC Standards, IoT categories, IoT gateways, challenges, Security concerns and hurdles, Overview of applications - home automation, agriculture, Industrial, health care, Smart Grid.

Unit 02	**IoT Development platforms**	**06 hrs**

Basics of Microcontroller and Microprocessor, Introduction to Edge devices e.g. Arduino, Node MCU, Raspberry Pi. Comparative analysis of the Platforms.

Unit 03	**Programming the hardware**	**06 hrs**

Introduction to Integrated Development Environment, Overview of different IDE's, Example of programs using Arduino IDE, Basics of Python, Example of programs using Python.

Unit 04	**Sensing and Actuation**	**06 hrs**

Sensors, Types of sensors – Digital and Analog, characteristics, choosing right sensor for Application, Interfacing Sensor with Node MCU, Reading data from Sensors like LM35, DHT 11, Ultrasonic Sensor, IR Sensor, sound sensor, touch sensor, LDR, Potentiometer, Current and voltage Sensor, Connecting actuators - relay, stepper motor.

Unit 05	**Communication Technologies and Cloud**	**06 hrs**

Introduction to communication Technologies like Wi-Fi, Bluetooth, RFID, Z-Wave, Zigbee, 6LoWPAN, LORA, Wireless HART, MQTT, Introduction to cloud platforms.

Unit 06	**Development of IoT based Application**	**06 hrs**

Reading sensor data and sending it to cloud platform, Visualization and analysis of the data on cloud, actuation and control, case study – Home automation

Test Books:

[T1]	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
[T2]	Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
[T3]	Parikshit N. Mahalle & Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (e-book).
Reference Books:	
[R1]	Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web", ISBN : 978-1-84821-140-7, Willy Publications
[R2]	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications.
[R3]	Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things". Publisher: Lightning Source Inc; 1st edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978-0989973700.
[R4]	Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.
[R5]	Michael Margolis, Arduino Cookbook, 2nd Edition, O'Reilly Media, Inc, 2011.
[R6]	Alex Bradbury & Ben Everard, Learning Python with Raspberry Pi, 1st Edition, John Wiley & Sons, Feb 2014.
[R7]	Charles Bell, Beginning Sensor Networks with Arduino and Raspberry Pi, 1st Edition, Apress, 2014.

303151B: Elective-II: Electric Mobility

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Basic concept of Batteries, Electrical Motors, Power Electronics

Course Objectives: This course aims to

1. To make students understand the need & importance of Electric & Hybrid Electric vehicles.
2. To differentiate and analyze the various energy storage devices.
3. To impart the knowledge about architecture and performance of Electric and Hybrid Vehicles
4. To classify the different drives and controls used in electric vehicles.

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

CO1	Analyze the concepts of Hybrid and Electric vehicles.
CO2	Describe the different types of energy storage systems
CO3	Comprehend the knowledge of the battery charging and management systems.
CO4	Classify the different mode of operation for hybrid vehicle.
CO5	Apply the different Charging standards used for electric vehicles.
CO6	Differentiate between Vehicle to home & Vehicle to grid concepts.

Unit 01	**Introduction to Hybrid and Electric vehicles**	**06 hrs**

Need and importance of Electric Vehicle and Hybrid Electric Vehicles, Environmental importance of Hybrid and Electric vehicles. Hybrid Electric vehicles: Concept and architecture of HEV drive train (Series, parallel and series-parallel). Micro Hybrid, Mild Hybrid, Full Hybrid, Plug-in Hybrid, Electric vehicles: Components, configuration, performance, tractive effort, Advantages and challenges in EV.

Unit 02	**Energy Storage Systems**	**06 hrs**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery specifications, Battery based energy storage and its analysis, Classification of lithium-ion batteries, Aluminum Air and Aluminum ion battery. Fuel Cell based energy storage, Super Capacitor based energy storage, Hybridization of Ultra capacitor and Battery. Selection methodology for the energy storage.

Unit 03	**Battery Charging and Management Systems**	**06 hrs**

introduction: Different Charging algorithms and Charging method, Cell Balancing methods.
Battery Management System: Functions of BMS, Block diagram of BMS. SoC Estimation methods, Thermal Management of Battery.

Unit 04	**Hybrid Power Train and mode of operation**	**06 hrs**

Control Strategies and Design of the Major Components: Series and Parallel Hybrid Electric Drive Train. Energy Consumption in Braking, Braking Power and Energy on Front and Rear Wheels, Brake System of EVs and HEVs, Regenerative braking

Unit 05	**Drives and Charging Infrastructure**	**06 hrs**

Selection of drives for Electric vehicle: PMSM drive and BLDC drive, Sizing of motor, Charging Levels: 01,02 and 03, Charging Standards: CCS, CHAdeMO, SAE J1772, IEC 60309, Bharat DC 001, Bharat AC 001, Electric Vehicle Supply Equipment (EVSE).

Unit 06	**Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid**	**06 hrs**

Vehicle to Home: Introduction, applications, V2H with demand response, Case Study of V2H.
Vehicle to Grid: Introduction of V2G, V2G infrastructure in the smart grid, Role of aggregator for V2G, Case study of V2G, Vehicle to Vehicle: Introduction of V2V, Concept & structure.

Test Books:

[T1]	"Electrical Vehicle", James Larminie and John Lowry, John Wiley & Sons, 2012.

[T2]	"Electric and Hybrid-Electric Vehicles", Ronald K. Jurgen, SAE International Publisher.
[T3]	"Energy Systems for Electric and Hybrid Vehicles", K T Chau, The institution of Engineering and Technology Publication
[T4]	"Batteries for Electric Vehicles", D.A.J Rand, R Woods & R M Dell ,Research studies press Ltd, New York, John Willey & Sons
[T5]	Electric & Hybrid Vehicles-Design Fundamentals, CRC press
Reference Books:	
[R1]	"Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", Mehrdad Ehsani, Yimin Gao and Ali Emadi. CRC Press, 2009.
[R2]	"Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", Junwei Lu & Jahangir Hossain et al (eds), IET Digital Library.
[R3]	"Automobile Electrical and Electronic systems", Tom Denton, SAE International publications.
[R4]	"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011.
[R5]	The Electric Vehicle Conversion handbook –Mark Warner, HP Books, 2011.
Online Resources:	
[O1]	https://www.theiet.org/resources/books/transport/vehicle2grid.cfm?
[O2]	https://www.sae.org/publications/books/content/pt-143.set/
[O3]	http://nptel.ac.in/courses/108103009/

303151C:Elective-II: Cybernetics Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Laplace transform, basics of matrices, computer programming and fundamentals.

Course Objectives: This course aims to

1. Introduce the concept of engineering cybernetics.
2. Give basic knowledge of key topics in cybernetics, such as system theory, control engineering, embedded computer systems, mathematical modeling, simulation, and optimization.

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

CO1	Define cybernetics in terms of control and how is it used in controlling technical, biological, and other processes.
CO2	Understand various matrix operations.
CO3	Describe different types of control system configurations and their applications.
CO4	Carry out mathematical modeling and simulation of simple processes.
CO5	Appreciate the essential requirements for computers and computer equipment that are intended to operate in dedicated applications and industrial environments.
CO6	Know intelligent optimization techniques.

Unit 01	**Introduction to Cybernetics**	**06 hrs**

History of Cybernetics, various definitions of cybernetics, Control or regulation in machines, Control or regulation in human affairs.

Unit 02	**Linear system theory**	**06 hrs**

Vector Spaces, Bases, Coordinate Transformation, Invariant Subspaces, Inner product, Norms, Rank, Types of Matrices, Eigenvalues, Eigenvectors, Diagonalization, Matrix Factorization.

Unit 03	**Control Engineering**	**06 hrs**

Introduction to control systems, basic terminologies, Linearization. Laplace transform and transfer functions, types of control systems, introduction of nonlinear control system, adaptive control system, optimal control system, multivariable control system and their examples and applications.

Unit 04	**Mathematical Modeling and Simulation**	**06 hrs**

Mathematical modeling of physical processes, Differential equations of physical systems, such as electrical, mechanical, fluid, linear approximation, solution of ordinary differential equations using ODE solvers.

Unit 05	**Embedded computer systems**	**06 hrs**

Design of embedded computer systems. Computer architectures and system components for embedded and industrial applications. Microcontrollers and specialized microprocessors. Parallel and serial bus systems. Data communication in industrial environments. Analog/digital interfaces.

Unit 06	**Modern Optimization Methods**	**06 hrs**

Definition, applications, types of methods for optimization, Introduction to modern optimization techniques, Genetic algorithm, Simulated Annealing method, Particle Swarm Optimization, Ant Colony method.

Test Books:

[T1]	https://asc-cybernetics.org/foundations/history.htm [Online available on 30.05.2021]
[T2]	Dan C. Marinescu, "Complex Systems and Clouds A Self-Organization and Self-Management Perspective", Elsevier, United States, 2017
[T3]	C-T Chen, "Linear System Theory and Design", Oxford University Press, 1999
[T4]	Richard C. Dorf, Robert H. Bishop, "Modern Control System", Pearson Education Limited, 2011
[T5]	Hassan K. Khalil, "Nonlinear Control", Pearson Education Limited, 2011

[T6]	Karl Johan Astrom, Bjorn Wittenmark, "Adaptive Control", Dover Publications Inc., New York 2008
[T7]	Y. S. Apte, "Linear Multivariable Control Systems", McGraw-Hill, 1981
[T8]	Nirmala Sharma, "Computer Architecture", Laxmi Publication, 2009
[T9]	Soliman Abdel- Hady Soliman, Abdel-Aal Hassan Mantawy, "Modern Optimization Techniques with Applications in Electric Power Systems" Springer

303151D:Elective-II Energy Management

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Various electrical equipment and specifications, Construction and operation of different equipment/process like HVAC, Pumps, Compressors etc.

Course Objectives: The course aims to:-

1. Understand importance of energy Conservation and energy security and impact of energy use on environment.
2. Follow format of energy management, energy policy.
3. Understand demand side management tools and impact of tariff on demand management.
4. Importance of Data Analytics in Energy audit and audit process.
5. Calculate energy consumption and saving options with economic feasibility.
6. Use of appropriate energy conservation measure in field applications or industry.

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

CO1	Describe BEE Energy policies, Energy ACT.
CO2	List and apply demand side management measures for managing utility systems.
CO3	Explore and use simple data analytic tools.
CO4	Use various energy measurement and audit instruments.
CO5	Evaluate economic feasibility of energy conservation projects.
CO6	Identify appropriate energy conservations methods for electric and thermal utilities.

Unit 01 Energy Scenario **06 hrs**

Classification of Energy resources, Commercial and noncommercial sources, primary and secondary sources, commercial energy production, final energy consumption. Energy needs of growing economy, short terms and long terms policies, energy sector reforms, energy security, importance of energy conservation, energy and environmental impacts, introduction to CDM, UNFCCC, Paris treety, emission check standard, salient features of Energy Conservation Act 2001 and Electricity Act 2003. Latest amendments in Electricity Act. Indian and Global energy scenario. Introduction to IE Rules. Study of Energy Conservation Building Code (ECBC).

Unit 02 Energy Management **06 hrs**

Definition and Objective of Energy Management, Principles of Energy management, Energy Management Strategy, Energy Manager Skills, key elements in energy management, force field analysis, energy policy, format and statement of energy policy, Organization setup and energy management. Responsibilities and duties of energy manager under the latest Act. Energy Efficiency Programs. Energy monitoring systems.

Unit 03 Demand Management **06 hrs**

Supply side management (SSM), Generation system up gradation, constraints on SSM. Demand side management (DSM), advantages and barriers, implementation of DSM. Use of demand side management in agricultural, domestic and commercial consumers. Demand management through tariffs (TOD). Power factor penalties and incentives in tariff for demand control. Apparent energy tariffs. Role of renewable energy sources in energy management, direct use (solar thermal, solar air conditioning, biomass) and indirect use (solar, wind etc.) Introduction to ISO 50001- Energy Management.

Unit 04 Energy Audit **06 hrs**

Definition, need of energy audits, types of audit, procedures to follow, data and information analysis, Introduction to Data Analytics, data quality processing, clustering techniques, pattern mining, regression and classification. Relevance of Data Analytics in Audit, energy audit instrumentation,

energy consumption – production relationship, pie charts. Sankey diagram, Cusum technique, least square method and numerical based on it. Outcome of energy audit and energy saving potential, action plans for implementation of energy conservation options. Bench- marking energy performance of an industry. Energy Audit reporting format – Executive Summary , Detailing of report.

Unit 05	**Financial Analysis**	**06 hrs**

Financial appraisals; criteria, simple payback period, return on investment, net present value method, time value of money, break even analysis, sensitivity analysis and numerical based on it, cost of energy, cost of generation Energy Audits case studies – Sugar Industry, Steel Industry, Paper and Pulp industry.

Unit 06	**Energy Conservation**	**06 hrs**

a) Motive power (motor and drive system). b) Illumination c) Heating systems (boiler and steam systems) d) Ventilation(Fan, Blower and Compressors) and Air Conditioning systems e) Pumping System f) Cogeneration and waste heat recovery systems g) Utility industries (T and D Sector) and Performance Assessments.

Test Books:

[T1]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 1, General Aspects (available on line)
[T2]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 2 – Thermal Utilities (available on line)
[T3]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 3- Electrical Utilities (available on line)
[T4]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 4 (available on line)

Reference Books:

[R1]	Success stories of Energy Conservation by BEE (www. Bee-india.org)
[R2]	Utilization of electrical energy by S.C. Tripathi, Tata McGraw Hill.
[R3]	Energy Management by W.R. Murphy and Mackay, B.S. Publication.
[R4]	Generation and utilization of Electrical Energy by B.R. Gupta, S. Chand Publication
[R5]	Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.
[R6]	A General Introduction to Data Analytics by Andre Carvalho and Tomáš Horváth Wiley Inc First Edition 2019.

Online Resources:

[O1]	www.energymanaertraining.com
[O2]	www.em-ea.org
[O3]	www.bee-india.org
[O4]	https://www.iso.org/iso-50001-energy-management.html

Unit	**Text Books**	**Reference Books**
Unit 1	T1	O1, O2
Unit 2	T1	O1, O2
Unit 3	T1	R4, O4
Unit 4	T1	R4, R5 and O1 and O2, R6
Unit 5	T1 and T4	R1, R2, R3, R5 O1 and O2
Unit 6	T2, T3 and T4	R1, R5 and O1 and O2

303152: Internship

Teaching Scheme			Credits		Examination Scheme	
IN	04	Hr/Week	**IN**	04	**TW**	100 Marks

Preamble

Internship is a short-term industrial working experience for the students. The internship aims at providing entry-level exposure to a particular industry. It is expected that students should spend time working on relevant projects or part of the project and acquire learning about the field, along with developing industry connections, and employability skills.

Course Objectives:

1. Encourage and provide opportunities to the students to acquire professional learning experiences.
2. Empower students to relate and then apply the theoretical knowledge in real-life industrial situations.
3. Provide exposure for handing and using various tools, measuring instruments, meters, and technologies used in industries.
4. Enable students to develop professional and employability skills and expand their professional network.
5. Empower students to apply the internship learnings to the academic courses and project completions.
6. Impart professional and societal ethics in students through the internship.
7. Make students aware of social, economic, and administrative aspects influencing the working environment of the industry.

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

CO1	Understand the working culture and environment of the Industry and get familiar with various departments and practices in the industry.
CO2	Operate various meters, measuring instruments, tools used in industry efficiently and develop technical competence.
CO3	Apply internship learning in other course completions and final year project management, i.e. topic finalization, project planning, hardware development, result interpretations, report writing, etc.
CO4	Create a professional network and learn about ethical, safety measures, and legal practices.
CO5	Appreciate the responsibility of a professional towards society and the environment.
CO6	Identify career goals and personal aspirations.

Guidelines: The guidelines related to the internship are given below.

Duration: Guidelines related to duration are as follows.

1. The internship should be started after semester 5 and should be completed before the commencement of semester 6.
2. It should be for at least 4 to 6 weeks.
3. It should be assessed and evaluated in semester 6.

2. Internship Identification:

A student may choose to undergo an Internship at Industries, Government organizations, NGOs, Micro-Small-Medium enterprises, startups, Innovation and Incubation Centers, Institutes of National interests, organizations working for rural development, organizations promoting IPR and Entrepreneurship, etc. Approaching various industries for Internships and finalizing the same should be initiated in the 5th semester in consultation with Institute's Training and Placement Cell, Industry-Institute Cell, or Internship Cell. This will help students to start their internship work on time. Also, it will allow students to work in a vacation period after their 5th-semester examination and before the start of the 6th semester. Student can take internship work in the form of Online/Onsite work from any

of the following but not limited to:

1. Working for consultancy or the funded research project of the institute/Department.
2. Contributing at Incubation, Innovation, Entrepreneurship Cell, Institutional Innovation Council, Start-up Cell of Institute where students will get learning opportunities on projects.
3. Learning at Departmental Lab leading to lab development and modernization, Tinkering Lab, Institutional workshop for prototyping and model development, etc.
4. Working at Industry or Government Organization on project or part of the project.
5. Internship through Internshala, AICTE, Government initiatives, etc.
6. In-house product or working model development, intercollegiate, inter-department research under research lab or research group, etc.
7. Working at micro-small-medium enterprises on solving their specific problems.
8. Research internship under professors at IISc, IIT's, NIT's, Research organizations, etc.
9. Working with NGOs or Social Internships, Rural Internship, etc.

Further, other internship opportunities should be discussed and finalized in consultation with Department/Institute constituted committees for Internship.

3. Internship Record Book:
Students must maintain an Internship record book. The main purpose of maintaining a record book is to nurture the habit of documenting and keeping records by students. The students should maintain the record of daily activities completed which may include, field visits, important discussions, observations, project work completed, suggestions received, etc. The record book should be signed every day by the supervisor or in-charge where the student is undergoing an internship. The internship record book and well-drafted Internship Report should be submitted by the students to the department faculty coordinator within a week after the completion of the internship.

4. Internship Evaluation:
The evaluation of activities recorded in the Internship Record Book will be done by Program Head, Cell In-charge, Project Head, faculty mentor, or Industry Supervisor based on the overall compilation of internship activities, sub-activities, the level of achievement expected, and the duration for certain activities. Assessment and Evaluation are to be done in consultation with the internship supervisors (Internal from the institute and External from industry).

5. Evaluation and Assessment of Internship:
Internship Record Book – 25 Marks + Internship Report - 25 Marks + Post Internship Internal Evaluation-50 Marks = Total 100 Marks

5.1 Internship Record Book: The attendance record of the student along with the evaluation sheet, duly signed and stamped by the industry should be submitted by the industry Supervisor or Mentor to the Institute/Department after the completion of the internship. The internship record book may be evaluated based on the following criteria:

- Proper and timely documented entries
- Adequacy and quality of information
- Data, observations, discussions recorded
- Thought process and recording techniques used
- Organization of the information

5.2 Internship Report: After completion of the Internship, the student should prepare a comprehensive report to indicate what he/she has observed and learned in the internship period. The report shall be presented covering the following recommended fields but not limited to:

- Title/Cover Page
- Internship certificate with details like company name, location, duration, supervisor, etc.
- Institute Certificate
- Declaration
- Abstract
- Index/Table of Contents
- List of Figures/Tables
- **Chapter 1:** Introduction: Brief about company, industry or organization, objectives, motivation, organization of the report
- **Chapter 2:** Problem Identification/Problem statement/objectives and scope/expected outcomes
- **Chapter 3:** Methodological details
- **Chapter 4:** Results / Analysis /inferences and conclusion
- **Chapter 5:** Suggestions/Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library books, magazines, and other sources)

5.3 Post Internship Internal Evaluation: The student will give a presentation based on his Internship report before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

1. Internship Identification and Selection
2. Problem Studied with objectives and expected outcomes
3. Consideration of Environment/ Social /Ethics/ Safety measures/Legal aspects.
4. Methodology/System/Procedure Q&A
5. Block-diagram, flow-chart, algorithm, system description Q&A
6. Final results, discussions, suggestions, comments, etc. Q&A
7. Presentation and Communication

6. Feedback from internship supervisor (External and Internal)

Post internship, the faculty Internship coordinator should collect feedback about the student on the following suggested parameters from Industry Supervisor.

- Technical knowledge,
- Discipline and Punctuality,
- Work Commitment,
- Willingness to do the work,
- Communication skills, etc.

303153A: Audit Course IV: Ethical Practices for Engineers						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP
Prerequisite:						
Basic understanding of business management						
Course Objectives: This course aims to						
Create awareness to serve the public by strictly adhering to codes of conduct and placing paramount the health, safety and welfare of public.						
Course Outcomes: At the end of this course, student will be able to						
CO1	Understand for their professional responsibilities as Engineers.					
CO2	Recognize and think through ethically significant problem situations that are common in Engineering.					
CO3	Evaluate the existing ethical standards for Engineering Practice.					
Unit 01	**Introduction: Justice and Moral**					**12 hrs**
Introduction to Ethical Reasoning and Engineer Ethic, Professional Practice in Engineering, Ethics as Design - Doing Justice to Moral Problems, Central Professional Responsibilities of Engineers.						
Unit 02	**Rights and Responsibility**					**12 Hrs**
Computers, Software, and Digital Information, Rights and Responsibilities Regarding Intellectual Property, Workplace Rights and Responsibilities, Responsibility for the Environment.						
Test Books:						
[T1]	Ethics in Engineering practice and Research (2nd Edition) by Caroline Whitbeck Cambridge					
[T2]	Ethics in Engineering MW Martin and R Schinzinger MC Graw Hill					
[T3]	Engineering Ethics and Environment P a Vesilind and AS Gunn Cambridge					
Online Resources:						
[O1]	NPTEL course on “Ethics in Engineering Practice”, By Prof. Susmita Mukhopadhyay, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc19_hs35/preview					

303153B:Audit Course VI: Project Management						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	02	Hr/Week	**TH**	00	**GRADE**	**PP/NP**

Prerequisite:

Course Objectives: This course aims to

1. Plan a successful project through project management.
2. Select the right members of a team for a project.

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

CO1	Elaborate importance of project management and its process.
CO2	Learn about the role of high performance teams and leadership in project management.

Unit 01	**Basics of Project Management:**	**12 hrs**

Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

Unit 02	**Project Identification, Selection, planning:**	**12 hrs**

Project Identification, Selection Introduction, Project Identification Process, Project Initiation, Pr-Feasibility Study, Feasibility Studies, Project Break-even point

Project Planning: Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)

Test Books:

[T1]	Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner.
[T2]	Guide to Project Management: Getting it right and achieving lasting benefits by Paul Roberts.

Online Resources:

[O1]	https://www.coursera.org/learn/project-planning?specialization=project-management
[O2]	Project management for managers By Prof. Mukesh Kumar Barua, IIT Roorkee https://onlinecourses.nptel.ac.in/noc20_mg48/preview