AC-
Item No.

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Electrical Engineering

Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

AC:
Item No.

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Final Year of B.E in Electrical Engineering**
2	Eligibility for Admission	**After Passing Third Year Engineering as per the Ordinance 0.6243**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6243**
5	No. of Years / Semesters	**8 semesters**
6	Level	**Under Graduation**
7	Pattern	**Semester**
8	Status	**Revised**
9	To be implemented from Academic Year	**With effect from Academic Year: 2022-2023**

Date:

Dr. S. K. Ukarande
Associate Dean, Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean, Faculty of Science and Technology
University of Mumbai

Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning. Therefore, in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self-learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Fourth Year of Engineering from the academic year 2022-23.

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Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self-learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C ' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self-learning to learner. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
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Dr Anuradha Muzumdar
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Faculty of Science and Technology
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Preface by BoS

The outcome based course curriculum for the undergraduate degree in Electrical Engineering in Rev.2019 'C' scheme has been chalked out through the thoughtful discussions and deliberations of academic and industry experts. While devising the syllabus content framework, the correct balance between the fundamental / core topics with appropriate mix of topics from the state of the art technologies in electrical and allied domains is attempted. With the increased Industry-Institute interaction and internship programs, students are encouraged to explore the opportunity to improve communication skills, problem solving skill and good team management. These skills shall surely help them to meet the future challenges in their career.

The new course curriculum will also give ample opportunity to the students to work in cross discipline domains to gain the hands on experience through the project based learning facilitated through the various skill based labs, Mini projects, Course projects , Major projects etc. The increased number of department and institute level electives shall facilitate students with the truly choice based learning and skilling in a particular domains.

On behalf of the Board of Studies (BoS) in Electrical Engineering of the University of Mumbai, we seek the active participation from all the stake holders of the engineering education to meet the set outcomes and objectives for the Undergraduate Program in Electrical Engineering.

Board of Studies in Electrical Engineering

Dr. Sushil Thale : Chairman
Dr. B. R. Patil : Member
Dr. S. R. Deore : Member
Dr. B. B. Pimple : Member
Dr. Nandkishor Kinhekar : Member

Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./ Tut.	Theory	Pract.	Total
EEC801	Electrical System Design, Management and Auditing	4	--	4	--	4
EEDO801X	Department Optional Course – 5	3	--	3	--	3
EEDO802X	Department Optional Course – 6	3	--	3	--	3
EEIO801X	Institute Optional Course - 2	3	--	3	--	3
EEL801	Electrical System Design and Audit Lab	--	2	--	1	1
EEL802	Measurement and Instrumentation Lab	--	2	--	1	1
EEP801	Major Project II	--	12#	--	6	6
Total		**13**	**16**	**13**	**8**	**21**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/ oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
EEC801	Electrical System Design, Management and Auditing	20	20	20	80	3	--	--	100
EEDO801X	Department Optional Course – 5	20	20	20	80	3	--	--	100
EEDO802X	Department Optional Course – 6	20	20	20	80	3	--	--	100
EEIO801X	Institute Optional Course - 2	20	20	20	80	3	--	--	100
EEL801	Electrical System Design and Audit Lab	--	--	--	--	--	25	25	50
EEL802	Measurement and Instrumentation Lab	--	--	--	--	--	25	25	50
EEP801	Major Project II	--	--	--	--	--	100	50	150
Total		**--**	**--**	**80**	**320**	--	**150**	**100**	**650**

Students group and load of faculty per week.

Major Project I and II:

Students can form groups with minimum 3 (Three) and not more than 4 (Four)

Faculty Load: In Semester VII – ½ hour per week per project group
In Semester VIII – 1 hour per week per project group

Department Optional Courses

Course Code	Sem. VIII: Department Optional Course- 5		Course Code	Sem. VIII: Department Optional Course - 6
EEDO8011:	Power Quality and FACTs		EEDO8021:	Power System Planning and Reliability
EEDO8012:	Automation and Control		EEDO8022:	Lighting System Design
EEDO8013:	Advanced Electric Drives		EEDO8023:	Cyber Physical Systems
EEDO8014:	High Power Switching Converters		EEDO8024:	Electric Vehicle System Design

Institute Optional Courses

Course Code	Institute Elective Course-II #
EEIO8021	Project Management
EEIO8022	Finance Management
EEIO8023	Entrepreneurship Development and Management
EEIO8024	Human Resource Management
EEIO8025	Professional Ethics and CSR
EEIO8026	Research Methodology
EEIO8027	IPR and Patenting
EEIO8028	Digital Business Management
EEIO8029	Environmental Management

 # Common with all branches

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEC801	**Electrical System Design, Management and Auditing**	Theory	Pract./Tut.	Theory	Pract /Tut.	Total
		4	**--**	**4**	**--**	**4**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEC801	**Electrical System Design, Management and Auditing**	**20**	**20**	**20**	**80**	**03**	**-**	**-**	**100**

Course Objectives	To impart knowledge of 1. Designing electrical distribution network 2. Electrical energy audit in the distribution system
Course Outcomes	Upon successful completion of this course, the learner will be able: 1. To do sizing, selecting transformer, switchgear and cable as required for distribution system 2. To illustrate Engineering knowledge in energy audit and energy efficient technologies to improve energy efficiency 3. Describe the energy conservation through energy monitoring and targeting 4. Analyse and Evaluate the energy audit data for targeting possible opportunities of energy saving

Module	Contents	Hours
1	Introduction: Types of electrical Projects, Types of electrical system, review of components of electrical system, different plans/ drawings in electrical system design, single line diagram in detail, Tendering, Estimation	05
2	Design of Power Distribution System: Different types of distribution systems and selection criteria, Electrical Earthing, Electrical load size, L.F, D.F, future estimates, substation equipment options, design considerations in transformer selection, sizing and specifications; Selection of HT/LT switchgears, metering, switchboards and MCC, protection systems, coordination and discrimination. IS standards applicable in above design	10
3	Selection / Sizing of Cable and Auxiliary system: Cables selection and sizing, cable installation and management systems, bus bars design; Basics of selection of emergency/backup supplies, UPS, DG Set, Batteries; Preliminary design of interior lighting system. IS standards applicable in above designs	07
4	Energy Monitoring and Targeting: Defining monitoring and targeting. Elements of monitoring and Targeting. Analysis techniques for energy optimization, Cumulative Sum of Differences (CUSUM), Electricity billing. Energy Management of Electrical Systems: Electrical load management and maximum demand control, Power factor improvement and its benefit, selection and location of capacitors, distribution and transformer losses.	10
5	Energy Audit: Introduction to Energy Conservation Act 2001, Energy Audit: Definition-need, Types of energy audit, Energy Management (audit) approach understanding energy costs, Bench marking, Maximizing system efficiencies, optimizing input energy requirement, fuel and energy substitution. Energy Audit instruments. Electrical Energy Performance Assessment: Motors and	10

	Variable Speed Drives, Lighting Systems. Basics of HVAC system assessment for electrical energy usage.	
6	**Energy Efficient Technologies:** Energy efficient BLDC Fans, Smart lighting system for indoor and outdoor applications, Maximum Demand controllers, Automatic Power Factor Controllers, Energy Efficient Motors, Soft starters, Variable Frequency Drives, Energy Efficient Transformer. Energy saving potential of each technology. Use of Energy Management system (EMS) and Building Management System (BMS).	10

Text Books:

1. Handbook of Electrical Installation Practice, Fourth Edition, by Geofry Stokes, Blackwell Science
2. Energy-Efficient Electric Motor, Third Edition, By Ali Emadi, New Marcel Dekker, Inc., 2005.
3. Electrical Energy Efficiency: Technologies and Applications by Andreas Sumper and Angelo Baggini, John Wiley & Sons, Ltd., 2012
4. Electrical Calculations and Guidelines for Generating Stations and Industrial Plants by Thomas E. Baker, CRC Publications, 2012
5. Electrical Installations Handbook, Third Edition, by Gunter Seip, MCD Verilag, 2000
6. Electrical Installation Designs, Fourth Edition by Bill Atkinson, Roger Lovegrove and Gary Gundry, John Wiley & Sons, Ltd, 2013.
7. Handbook of International Electrical Safety Practices, by Princeton Energy Resources International, Scrivener Publishing, 2010.
8. Designing with Light: Lighting Handbook, by Anil Valia, Lighting System
9. Energy Management Handbook||, by W.C. Turner, John Wiley and sons
10. Handbook on Energy Audits and Management||, by Amit Kumar Tyagi, TERI
11. Introduction to Efficient Electrical System Design, by Stephen Ayraud and Albert Thumann, The Fairmount Press

Reference Books:

1. Energy Auditing Made Simple||, by P. Balasubramanian, Seperation Engineers (P) Ltd
2. University of Mumbai, Electrical Engineering, Rev. 2016-17 Page 51
3. Electrical Installation Calculations: for Compliance with BS 7671:200, Fourth Edition, by Mark Coates, Brian Jenkins, John Wiley & Sons, Ltd, 2010
4. Energy Management Principles, by C.B. Smith, Peragamon Press
5. Energy Conservation Guidebook, by Dale R.Patrick, Stephon Fadro, E. Richardson, Fairmont Press
6. Handbook of Energy Audits||, by Albert Thumann, William J. Younger, Terry Niehus, CRC Press

Web Reference /Video Courses

1. http://www.energymanagertraining.com/
2. http://www.bee-india.nic.in/

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8011	**Power Quality and FACTs**	**Theory**	**Pract./Tut.**	**Theory**	**Pract /Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8011	**Power Quality and FACTs**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	1. To get awareness about non-linear loads in power system. 2. To understand the concept of Flexible AC Transmission System 3. To introduce the operation of various FACTS controllers.
Course outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Analyze the problems due to non-linear loads 2. Suggest the solution to improve power quality. 3. Illustrate the aspects of flexible ac transmission system over conventional ac transmission system and analyze the concept of load compensation. 4. Categorize the static shunt and series compensation for transmission line. 5. Outline the concept of voltage and phase angle regulators

Module	Contents	Hours
1.	Power Quality Introduction: Disturbances, Unbalance, Distortion, Voltage Fluctuations, Flicker, Quality Assessment	03
2.	Harmonics and its effects : Definition of harmonics, odd and even harmonics, Harmonic phase rotation and phase angle relationship, Causes of voltage and current harmonics, individual and total harmonic distortion with problems, Power assessment under waveform distortion with numerical. Effects of harmonics on rotating Machines, Transformers and Cables, Overloading of Neutral conductor	07
3.	Power quality improvement: Power factor when both voltage and current are sinusoidal, Power factor compensation using capacitor (vector diagram and numerical included), power factor when voltage is sinusoidal and current is non-sinusoidal (numerical included), Effect of capacitor compensation in power factor improvement under non-sinusoidal condition. Mitigation of harmonics- Passive filters- Advantages and disadvantages of passive filters- Active filters- shunt connection, series connection and hybrid connection, Instantaneous PQ theory.	10
4.	General concept of FACTS and Load Compensation: Transmission Interconnections, Flow of Power in AC system, What Limits the Loading Capability, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of controllable Parameters, Basic Types of FACTS Controllers, Benefits from FACTS Technology, Objectives in load compensation, ideal compensator, Practical considerations, Power factor correction and Voltage Regulation in single phase systems	08
5.	Static shunt and series compensators: Objectives of shunt compensation, Methods of controllable VAR generation, Variable impedance type static Var generator (TCR, TSR, TSC, FC-TCR), Switching converter type Var	08

	generators, basic operating principle. Objectives of series compensation, Variable impedance type series compensation (only GCSC, TSSC and TCSC), Switching converter type series compensation (only SSSC)	
6.	**Static voltage and phase angle regulators-** Objectives of voltage and phase angle regulators- TCVR and TCPAR	03

Text Books:-

1. "Power System Harmonics" Jos Arrillaga, Neville R Watson
2. "Electric Power Quality" , G.T.Heydt
3. "Electric Power Systems and Quality" , Roger C. Dugan,Mark F. McGranaghan, H.Wayne Beatyd
4. "IEEE-519 Standard
5. 'Hingorani N.G.. & Gyugi L., —Understanding FACTS : Concepts and Technology of Flexible AC Transmission Systems,|| Wiley-1EEE Press.
6. Timothy J. E. Miller —Reactive power control in Electric Systems,|| Wiley India Edition.

Reference Books:-

1. "Power System Quality Assessment", J. Arrillaga, N.R.Watson, S.Chen
2. "Power Quality" , C. Shankaran, CRC press
3. "Reactive power control in electric systems" by Timothy J. E. Miller
4. "Power Quality Enhancement Using Custom Devices" Arindam Ghosh, Gerard Ledwich
5. "Power Electronics" Ned Mohan, Undeland, Robbins, John Wiley Publication
6. "Power System Analysis- Short Circuit Load Flow and Harmonics" J.C.Das.
7. "Flexible AC transmission system" by Yong Hua Song Institution of Electrical Engineers, London

Website Reference/ Video Courses:

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8012	**Automation and Control**	**Theory**	**Pract./Tut.**	**Theory**	**Pract /Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8012	**Automation and Control**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	To impart the fundamentals knowledge in the field of Automation and Control
Course outcomes	**Upon successful completion of this course, the learner will be able to** 1. Understand basic terminologies and concepts associated with Automation and Control 2. Demonstrate comprehension of various Robotic sub-systems 3. Understand kinematics and dynamics to explain exact working pattern of robots

Module	Contents	Hours
1.	**Introduction:** Basic concepts of Automation: Definition, three laws, DOF; Elements of Robotic Systems: Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance. Automation: Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Levels of Automations	06
2.	**Robot Grippers and Sensors:** Types of Grippers, Design aspects for gripper, Force analysis for various basic gripper system. Sensors for Robots: Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.	08
3.	**Drives and Control Systems:** Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems -Types of Controllers. Control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Control System Components such as Sensors, Actuators and others.	06
4.	**Kinematics:** Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:-Jacobians, singularities, static forces, Jacobian in force domain. Dynamics:- Introduction to Dynamics, Trajectory generations	08
5.	**Machine Vision System:** Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation. Robot Programming :- Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands,	06

	subroutines.	
6.	**Modeling and Simulation for manufacturing Plant Automation:** Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.	05

Text Books:-

1. John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 04
2. Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.
3. Shimon Y. Nof, Handbook of Industrial Robotics, John Wiley Co, 01.
4. Automation, Production Systems and Computer Integrated Manufacturing, M.P. Groover, Pearson Education.
5. Industrial Automation: W.P. David, John Wiley and Sons

Reference Books:-

1. Richard D. Klafter , Thomas A. Chemielewski, Michael Negin, Robotic Engineering : An Integrated Approach , Prentice Hall India, 02.
2. Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8013	**Advanced Electric Drives**	**Theory**	**Pract./Tut.**	**Theory**	**Pract /Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8013	**Advanced Electric Drives**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	To impart the knowledge of 1. The advanced control techniques used in induction motor (IM) drives 2. The control of Sinusoidal Surface Permanent Magnet (SPM) synchronous machine (PMSM) drives
Course outcomes	**Upon successful completion of this course, the learner will be able to:** 1. To select suitable V/f control scheme of IM based on the application. 2. To illustrate vector control and indirect vector control of IM. 3. To explain how to achieve sensorless vector control of IM. 4. To discuss various adaptive control schemes used in IM drives 5. To analyze direct torque control (DTC) used in induction motor drives. 6. To describe the speed control schemes used in PMSM drives

Module	Contents	Hours
1.	**Introduction:** Variable frequency operation of three phase symmetrical induction machine, Scalar control methods – Voltage fed inverter control: Open loop V/f control; Closed loop V/f control with slip regulation; Closed loop V/f control with torque and flux control, Current controlled voltage fed inverter drive, Current fed inverter drive with speed and flux control, Efficiency optimization control by flux program.	08
2.	**Vector control of Induction Motor (IM):** Introduction, Direct or feedback vector control, Flux vector estimation – Voltage model and current model, Indirect or feed forward vector control, Slip gain tuning, Stator flux oriented vector control.	10
3.	**Sensorless vector control of IM:** Slip calculation, Direct synthesis from state equations, Model Referencing Adaptive System (MRAS), Speed adaptive flux observer, Extended Kalman filter.	05
4.	**Adaptive control of IM:** Self tuning control, MRAC, Sliding mode control, Fuzzy control, Neural control.	05
5.	**Direct Torque and Flux Control of IM**: Conventional Direct torque and flux control (direct torque control (DTC)) of IM using switching table of inverter voltage vectors.	05
6.	**Synchronous Motor Drives:** Sinusoidal SPM Machine Drives: V/Hz control, self-control, Vector control.	06

Text Books:-

1. Modern Power Electronics and A.C. Drive||, B. K. Bose, PHI.
2. Electric Motor Drives: Modeling, Analysis and Control||, R.Krishnan,.PHI
3. Control of Electrical drives||, W. Leonhard, Springer-Verlag,

Reference Books:-

1. Power Semiconductor Controlled Drives||, G. K. Dubey, Prentice-Hall International.

2. Fundamentals of Electrical Drives||, G. K. Dubey, Narosa Publishing House.
3. Analysis of Electric Machinery||, P.C. Krause, McGraw Hill, New York

Website Reference/ Video Courses:

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8014	**High Power Switching Converters**	**Theory**	**Pract./Tut.**	**Theory**	**Pract /Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8014	**High Power Switching Converters**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	1. To understand and select high power devices, gain knowledge about power modules, suitable packaging and latest market trends. 2. To understand and analyse high power converters and the protection needed for the converters. 3. To keep abreast with the latest technologies and research going on in different areas related to high power converters. 4. To enhance the knowledge of practical aspects in the design of Power Converters. 5. To deliver technological solution in the field of power electronics.
Course outcomes	**Upon successful completion of this course, the learner will be able to** 1. Analyze and understand high power devices and practical issues in implementing high power converters. 2. Understand protection aspects and design considerations to build proper power electronics systems. 3. Design closed loop control and discretize controllers for using digital control methods. 4. Analyze and design converters in the fields of drives, power generation and energy conversion, industrial applications, extraction of energy from renewable sources

Module	Contents	Hours
1.	High power switching devices: Review of high power devices - diodes, SCRs, GTOs and IGBTs-ratings and switching characteristics, view of power device market trend, series connected devices, voltage equalization techniques-static and dynamic, constraints in paralleling IGBTs, intelligent power modules, packages for high power devices, wide band gap devices.	04
2.	High power converters and Protection: Multi pulse controlled rectifiers-12 pulse, introduction to higher pulse controlled rectifiers, Cascaded H bridge multilevel inverters, Modular Multi level converters, Practical Aspects in Building Three-Phase Power Converters- Motor drives, Grid applications, Protection aspects-Over current, Over voltage, temperature, snubber design-component selection, basics of resonant snubber and regenerative snubber, numerical.	10
3.	Design considerations: Electrical specifications, Mechanical specifications, Environmental specifications, EMI/EMC specifications, Hardware specifications, Thermal Management, Selection of switching frequency, Selection of switching device and topology, control and isolation, cost.	06

4.	Closed-Loop control: Analog PWM controllers, Digital control-advantages, Signal conditioning and sampling, digital implementation of PWM modulator-single update and double update mode, PI & PR controller discretization, effect of computational delay, Processors in converter control, Grid synchronization techniques, introduction to non-linear control methods.	08
5.	High power AC drives: Line side requirements, motor side challenges, switching device constraints, converter configurations, control aspects, case studies of drive application.	05
6.	Grid interfaced converters: Requirements and challenges, high power grid interfaced converters, current control, voltage control, grid synchronization, filter design, dc link voltage control, case studies on grid interfacing of renewable energy sources.	06

Text Books:-

1. Dorin O. Neacsu, "Switching Power Converters, Medium and High Power", CRC press, Taylor & Francis group, second edition, 2017.
2. Bin Wu, "High Power Converters and AC drives", IEEE press, John Wiley & Sons.
3. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
4. Simon Ang, Alejandro Oliva, "Power-Switching Converters", Taylor and Francis group.
5. A Yazdani, R. Iravani, "Voltage- Sourced Converters in Power Systems", Wiley, IEEE press.
6. B. Jayant Baliga, "Silicon Carbide Power Devices", World Scientific, 2005.

Reference Books:-

1. R. Teodoresco, M. Liserrie,P. Rodr´ıguez "Grid Converters for Photovoltaic and Wind Power Systems", John Wiley and Sons.
2. L. Umanad, "Power Electronics: Essentials & Applications", Wiley.
3. V. Ramanarayanan, "Course Material on Switched Mode Power Conversion", 2007.
4. M. Jamil, M. Rizwan, D.P Kothari, "Grid Integration of Solar Photovoltaic Systems", CRC press, Taylor & Francis.
5. Peter Friedrichs, T. Kimoto, L. Ley and G. Pensl, "Silicon Carbide, Volume 2: Power Devices and Sensors", Wiley Publications, 2011.

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8021	**Power System Planning and Reliability**	**Theory**	**Pract./Tut.**	**Theory**	**Pract /Tut.**	**Total**
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8021	**Power System Planning and Reliability**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	Student shall be able 1. To use reliability theory as a tool for decision support for design, operation and planning of electric power system. 2. To familiarize the students with various aspects of probability theory. 3. To acquaint the students with reliability and its concepts. 4. To introduce the students to methods of estimating the system reliability of simple and complex systems.
Course outcomes	**Upon successful completion of this course, the learner will be able to** 1. To explain the basic modelling of power system components for reliability evaluation and planning. 2. To describe load forecasting models for short-term and long-term power system planning. 3. To describe the methodologies to solve generation system reliability calculation and generation planning. 4. To describe how to calculate reliability indices for combined generation and transmission systems. 5. To carry out planning and reliability for distribution system.

Module	Contents	Hours
1.	Power System Planning and Load Forecasting: Objectives of power system planning, Short term, medium term and long term planning; Classification and characteristics of loads, Load forecasting methods: Extrapolation, Co-Relation Techniques; Energy forecasting, Weather load model, Peak load forecasting	08
2.	Basic Concepts of Reliabilit:y Failure analysis and Reliability parameters, Hazard models and Bath-tub curve, Series and Parallel Systems, Continuous Markov process, Frequency and Duration approach	08
3.	Generation Planning and Reliability: Generation system model, Capacity Outage Probability Table, Recursive algorithm for systems including derated states, Evaluation of Loss of Load Expectation, Evaluation of Loss of Energy Expectation	08
4.	Composite Generation and Transmission Systems: Radial configurations, Conditional probability approach, Network configurations System and load point indices, Application to practical systems	06
5.	Distribution Planning and Reliability: Evaluation techniques, Additional interruption indices, Application to radial systems	06
6.	Impact of Renewable Energy penetration: Impact analysis of high renewable energy penetration on stability and reliability of power system. Case studies based on Solar PV and Wind generation loss.	05

Text / Reference Books:-

1. Power System Planning - R.N. Sullivan, Tata McGraw Hill Publishing Company Ltd.
2. Modern Power System Planning - X. Wang & J.R. McDonald, McGraw Hill Book Company.
3. Electrical Power Distribution A.S. Pabla Tata McGraw Hill Publishing Company Ltd.
4. Reliability Evaluation of Engineering System - Roy Billinton & Ronald N. Allan, Springer Publication.
5. Reliability Evaluation of Power System - Roy Billinton & Ronald N. Allan, Springer Publication.
6. Electrical Power Distribution Engineering - T. Gonen, McGraw Hill Book Company.

Website Reference/ Video Courses:

1. **NPTEL Course:** Operation and Planning of Power Distribution Systems By Prof. Sanjib Ganguly, IIT Guwahati

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8022	**Lighting System Design**	Theory	Pract./Tut.	Theory	Pract /Tut.	Total
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8022	**Lighting System Design**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	1. To introduce various laws of illumination, lighting parameters, light sources, luminaries and their characteristics to be used for lighting design. 2. To introduce lighting design considerations for interior and exterior applications. 3. To adapt to the LED based solid state lighting with different lighting control technologies and standards.
Course outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Identify and describe the various laws of illumination, lighting parameters, light sources, luminaries and their Photometric characteristics. 2. Identify and describe various LED lighting components / subsystems, thermal management and lifetime studies. 3. Formulate and design an Interior Lighting system through standards, design considerations and calculation for different application areas. 4. Formulate and design an Exterior Lighting system through standards, design considerations and calculation for different application areas. 5. Identify and describe different Lighting Control schemes. 6. Identify and describe Solid-State Lighting technology, it's applications in Lighting for health and safety and solar powered schemes.

Module	Contents	Hours
1.	Introduction: Review of Light, Color and Photometry: Laws of illumination, illumination entities. Radiometric and photometric standards, Photometric measurement procedure-assessment of lamp efficacy, Color temperature, Colorimetry- Measurement of CRI, Glare, Solid-State Lighting: Drivers for LED lamps, standards and regulations, LED luminaries, LED Light Distributions,	04
2.	Lamps and Luminaries: Lamp: Review of development, construction and characteristics: Incandescent lamp, Discharge lamps, induction lamp, and LED lamp; LED Lighting Components and Subsystems, OLEDs, light-emitting polymers (LEPs) Thermal Management and Lifetime Studies; Luminaire: optical control, Control gear: ballast, standard and electronic, Luminaries photometry, Luminaire testing procedures	08
3.	Interior Lighting Design & Calculation: Objectives, quality and quantity of lighting. Lamp /Luminaire selection and placement, design considerations and calculation. Glare Consideration and control. Indoor lighting design by lumen method, by point by point method. Applications: residential, educational institute, industries, sports centers, commercial premises: retail stores, offices etc. Applicable standards.	12
4.	Exterior Lighting Design & Calculation: Exterior lighting system- Road lighting system, Utility area lighting, Sports lighting, Decorative flood lighting. Applicable standards	06

5.	**Lighting Control:** Introduction to Lighting Control, Controls, Selection of Lighting Controls, Design of Lighting Control Scheme, Lighting and LEED, Daylighting control, Controlling LED Lighting Systems, Smart Lighting Fixtures, Digital Lighting Networks, DMX control.	04
6.	**Recent trends in Lighting:** Smart Street Lighting with Remote Monitoring and Control System, Solar Powered LED Lighting, Tunable White Lighting and RGB LED based Colored Lighting. Lighting for health and safety, Circadian Rhythm and Human Centric Lighting. DC Microgrid based Lighting System	05

Text Books:-

1. Anil Valia, Designing with Light – A Lighting Handbook, International Lighting Academy
2. M. Nisa Khan, Understanding LED Illumination, CRC Press 2013
3. Anil Valia, LED LIGHTING SYSTEMS All you need to know, International Lighting Academy
4. National Lighting Code- 2011
5. Kao Chen, Energy Management in Illumination Systems, CRC Press.
6. John L. Fetters, The Hand Book of Lighting Surveys and Audits, CRC Press.

Reference Books:-

1. Illuminating Engineering Society, —The IES Lighting Handbook, 10th Edition
2. J. L. Lindsey and S. C. Dunning, —Applied Illumination Engineering, Third Edition, Fairmont Press, 2016
3. Lamps and Lighting – Edited by J.R. Coaton and A.M. Marsden, 4th Edition
4. Lighting for health and safety – N.A. Smith, Butterworth-Heimann.
5. Human Factors in Lighting – Peter R. Boyce, Taylor & Francis.

Website Reference/ Video Courses:

1. **NPTEL Course:** Illumination Engineering, Prof. N.K. Kishore**,** IIT Kharagpur

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8023	**Cyber Physical Systems**	Theory	Pract./Tut.	Theory	Pract /Tut.	Total
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8023	**Cyber Physical Systems**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	1. To understand design, and analysis of cyber-physical systems - the tight integration of computing, control, and communication. 2. To explore various applications for CPS like in smart-grids, smart buildings, electric vehicle systems etc.
Course outcomes	**Upon successful completion of this course, the learner will be able to:** 1. Understand the Cyber-Physical Systems in the real world with hardware and software platforms. 2. Illustrate various automated control design aspects 3. Describe various methods of safety assurance in CPS 4. Correlate the safety aspects and attack related issues in CPS 5. Illustrate the impact of attack and defense against on CPS deployment in the fields like smartgrid, vehicular systems etc.

Module	Contents	Hours
1.	Introduction: Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS; CPS HW platforms: Processors, Sensors, Actuators, CPS Network, CPS SW stack RTOS, Scheduling Real Time control tasks.	06
2.	CPS Hardware platforms: Embedded systems, Hybrid systems, Control theory and systems, Computer-aided verification and synthesis, Complex networks, Programming models, Application areas: Transportation, medical devices, aerospace	08
3.	CPS software components: Mapping software components to ECUs, CPS Performance Analysis: effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion	06
4.	Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques. Stability Analysis: CLFs, MLFs, stability under slow switching, Performance under Packet drop and Noise.	06
5.	Methods for Safety Assurance of Cyber-Physical Systems: Advanced Automata based modelling and analysis: Basic introduction and examples, Timed and Hybrid Automata, Definition of trajectories, zenoness, Formal Analysis: Flow pipe construction, reachability analysis, Analysis of CPS Software, Weakest Pre-conditions, Bounded Model checking	08
6.	Secure Deployment of CPS: Attack models, Secure Task mapping and Partitioning, State estimation for attack detection; Case study: Vehicle ABS hacking, Power Distribution; Case study: Attacks on Smart grid.	05

Text Books:-

1. Lee, Edward Ashford, and Sanjit Arunkumar Seshia, Introduction to embedded systems: A Cyber-physical systems Approach, Lee & Seshia, 2011.
2. Alur, Rajeev, Principles of Cyber-Physical Systems, MIT Press, 2015.\
3. Raj Rajkumar, Dionisio de Niz and Mark Klein, Cyber-Physical Systems, Addison Wisley, 2017
4. Wolf, Marilyn. High-Performance Embedded Computing: Applications in Cyber-Physical Systems and Mobile Computing. Elsevier, 2014**.**
5. T. D. Lewis "Network Science: Theory and Applications", Wiley, 2009.
6. P. Tabuada, "Verification and control of hybrid systems: a symbolic approach", Springer-Verlag 2009.
7. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer 2007.
8. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996

Assessment:
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits assigned		
EEDO8024	**Electric Vehicle System Design**	Theory	Pract./Tut.	Theory	Pract /Tut.	Total
		3	**--**	**3**	**--**	**3**

Course Code	Course Name	Examination Scheme							
		Theory					Term work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEDO8024	**Electric Vehicle System Design**	**20**	**20**	**20**	**80**	**03**	**--**	**-**	**100**

Course Objectives	1. To illustrate the design philosophies used in the EV domain. 2. To explore the selection of power and control architecture of EV drives 3. To study the design aspects of EV battery packs and other auxiliary systems
Course outcomes	**Upon successful completion of this course, the learner will be able to** 1. To select and size the electric motor for a particular EV application and performance criteria 2. To select and size the battery pack to meet desired EV performance and 3. To design the EV drive system with functional safety considerations. 4. To illustrate the use of hybrid energy source for EV performance improvement 5. To illustrate the design aspects of Automotive Subsystem 6. To design the EV chargers and charging infrastructure

Module	Contents	Hours
1.	**Selection and Sizing of EV Electric Motors:** Electric Vehicle modelling, Tractive force calculations, Design considerations for 2Wand 4W EVs; Torque, power and Speed requirement, Traction Limit, Maximum Acceleration Limit, Maximum Grade Limit. Vehicle Power Demand during Driving Cycles. Application Examples of EV /HEV motors with vehicles and motor specifications.	07
2.	**Selection and Sizing of Energy Storage for EV:** Selection of type of Battery pack for 2W and 4W EVs; Battery pack sizing: Design considerations: Range per charge, range anxiety, EV motor power requirement; Impact of road conditions, environmental conditions and traffic conditions. Selection and sizing of Fuel cell for FCEV, design considerations; Battery-ultra-capacitor hybrid combination sizing, performance analysis.	08
3.	**Automotive Subsystem Design:** Electronic Control Unit (ECU) and its Control Features, Communications between ECUs. Acceleration and braking control, regenerative braking; Automotive Steering Systems. Design considerations of HVAC controller	06
4.	**EV System integration:** EMC design on ECU level, EMC design on system level and in special subsystems, Radiated emissions and Conducted emissions, EMI EMC measurements.	04
5.	**Design of EV Chargers:** Design considerations for AC charger: vehicle interface and charging protocol design. applicable charging standards Design of On-Board Charger (OBC)-Schematic, power topology and control, Power capacities. Design considerations of DC fast charger: vehicle interface and charging protocol design. Connectivity and applicable charging standards	08
6.	**Functional Safety of Automotive Electronics:**	06

	Functional Safety requirements of Automotive Electronics; ASIL identification and safety goal finalization, ISO 26262. Energy Storage integrity / protection: rupture and toxic gas management; low energy stranding, Unintended vehicle movement, shock protection, and Elimination of potential thermal/ explosive event.	

Text / Reference Books:-

1. Design and Control of Automotive Propulsion Systems by Zongxuan Sun and Guoming Zhu, CRC Press, 2015
2. Electric Vehicle Machines and Drives Design, Analysis and Application by K. T. Chau, IEEE Press and Wiley, 2015
3. I. Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
4. M. Ehsani, Y. Gao, S.E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press. 2005
5. Sheldon Williamsom, Energy Management Strategies for Electric and Plug-in Hybrid Vehicles, Springer 2013
6. J. Larminie and J. Lowry, Electric Vehicle Technology Explained, Wiley, 2003
7. EMC and Functional Safety of Automotive Electronics by Kai Borgeest, IET, 2018

Website Reference/ Video Courses:

1. NPTEL Web Course: Electric Vehicles - Part 1 by Prof. Amit Kumar Jain D IIT Delhi
2. NPTEL Web Course: Fundamentals of Electric vehicles: Technology & Economics, by Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha and Prof. L Kannan, IIT Madras,
3. NPTEL Web Course: Introduction to Hybrid and Electric Vehicles by Dr. Praveen Kumar and Prof. S. Majhi, IIT Guwahati
4. Infineon's IGBT Simulation Tools: https://www.infineon.com/cms/en/tools/landing/igbt.html
5. Semikron Semisel: https://www.semikron.com/service-support/semisel-simulation.html

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be randomly selected from all the modules.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8021	**Project Management**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8021	**Project Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. 2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1. Apply selection criteria and select an appropriate project from different options. 2. Write work break down structure for a project and develop a schedule based on it. 3. Identify opportunities and threats to the project and decide an approach to deal with them strategically. 4. Use Earned value technique and determine & predict status of the project. 5. Capture lessons learned during project phases and document them for future reference

Module	Contents	Hours
1	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	05
2	**Initiating Projects:** How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics.	06
3	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface; Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	08
4	**Planning Projects:** Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	06

5	**5.1 Executing Projects:** Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	08
6	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects, Multicultural and virtual projects **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	06

References:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7th Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9th Edition, Gower Publishing England

Assessment:

Internal Assessment for 20 marks:
Consisting **Two Compulsory Class Tests**
First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:
Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8022	**Finance Management**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8022	**Finance Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques. 2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand Indian finance system and corporate finance 2 Take investment, finance as well as dividend decisions

Module	Contents	Hours
1	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
2	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
3	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09

4	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
5	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
6	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8023	**Entrepreneurship Development and Management**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8023	**Entrepreneurship Development and Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To acquaint with entrepreneurship and management of business 2 Understand Indian environment for entrepreneurship 3 Idea of EDP, MSME
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand the concept of business plan and ownerships 2 Interpret key regulations and legal aspects of entrepreneurship in India 3 Understand government policies for entrepreneurs

Module	Contents	Hours
1	**Overview of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
2	**Business Plans and Importance of Capital to Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship and Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
3	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
4	**Indian Environment for Entrepreneurship:** key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc.	08
5	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08

6	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

References:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8024	**Human Resource Management**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8024	**Human Resource Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To introduce the students with basic concepts, techniques and practices of the human resource management 2 To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations 3 To familiarize the students about the latest developments, trends & different aspects of HRM 4 To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand the concepts, aspects, techniques and practices of the human resource management. 2 Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective. 3 Gain knowledge about the latest developments and trends in HRM. 4 Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Contents	Hours
1	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues	05
2	**Organizational Behaviour (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour • Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); • Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	07

3	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	06
4	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment – Job Satisfaction, employee morale • Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning Training & Development: Identification of Training Needs, Training Methods	05
5	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	06
6	**HR & MIS:** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM:** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations:** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, 2016, Pearson Publications

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3, then part (b) will, be from any module other than module 3)

4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8025	**Professional Ethics and Corporate Social Responsibility (CSR)**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8025	**Professional Ethics and Corporate Social Responsibility (CSR)**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To understand professional ethics in business 2 To recognized corporate social responsibility
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand rights and duties of business 2 Distinguish different aspects of corporate social responsibility 3 Demonstrate professional ethics 4 Understand legal aspects of corporate social responsibility

Module	Contents	Hours
1	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
2	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
3	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
4	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
5	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
6	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8026	**Research Methodology**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8026	**Research Methodology**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To understand Research and Research Process 2 To acquaint students with identifying problems for research and develop research strategies 3 To familiarize students with the techniques of data collection, analysis of data and interpretation
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Prepare a preliminary research design for projects in their subject matter areas 2 Accurately collect, analyze and report data 3 Present complex data or situations clearly 4 Review and analyze research findings

Module	Contents	Hours
1	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
2	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	07
3	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07

4	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f.** Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	08
5	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
6	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	04

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8027	**IPR and Patenting**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8027	**IPR and Patenting**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To understand intellectual property rights protection system 2 To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures 3 To get acquaintance with Patent search and patent filing procedure and applications
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 understand Intellectual Property assets 2 assist individuals and organizations in capacity building 3 work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Contents	Hours
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc.), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08

06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8028	**Digital Business Management**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8028	**Digital Business Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 To familiarize with digital business concept 2 To acquaint with E-commerce 3 To give insights into E-business and its strategies
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Identify drivers of digital business 2 Illustrate various approaches and techniques for E-business and management 3 Prepare E-business plan

Module	Content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts, Difference between physical economy and digital economy. **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services), Opportunities and Challenges in Digital Business	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, managing Risks in e –business, Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06

5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business:** From Idea to Realization-Business plan preparation Case Studies and presentations	08

References:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then, part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEIO8029	**Environmental Management**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		3	**--**	**3**	**--**	**3**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEIO8029	**Environmental Management**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**

Course Objectives	1 Understand and identify environmental issues relevant to India and global concerns 2 Learn concepts of ecology 3 Familiarise environment related legislations
Course Outcomes	Upon successful completion of this course, the learner will be able to: 1 Understand the concept of environmental management 2 Understand ecosystem and interdependence, food chain etc. 3 Understand and interpret environment related legislations

Module	Contents	Hours
1	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	10
2	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
3	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
4	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	10
5	Total Quality Environmental Management, ISO-14000, EMS certification.	05
6	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000

6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions**, **each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**.

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEL801	**Electrical System Design and Audit Lab**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		--	**2**		**1**	**1**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEL801	**Electrical System Design and Audit Lab**	---	---	---	---	--	**25**	**25**	**50**

Course Objectives	To explore the effectiveness of various energy efficient technologies from design and utilization perspective.
Course outcomes	Upon successful completion of this course, the learner will be able: 1. Prepare the SLD for electrical system 2. Evaluate the energy efficiency of the electrical systems 3. Size and select the cable for electrical distribution network 4. Analyse the impact of various energy efficient technologies 5. Illustrate the impact of fuel substitution on energy consumption 6. Design energy efficient electrical system

Syllabus: Same as that of Courses of Sem-VIII EEC801: Electrical System Design, Management and Auditing

Suggested List of Tutorials/Case Studies/ Experiments

1) Tutorial on developing of Single line diagram of your own house
2) Tutorial on illumination system for the given installation
3) Tutorial on EELD (Energy Efficient Lighting Design) in comparison to Standard lighting design in terms of LPD
4) Tutorial on designing of power distribution network for a given installation
5) Tutorial on sizing and selection of Cables for electrical distribution network
6) Tutorial Motor retrofitting by Energy Efficient Motor
7) Tutorial on CUSUM analysis of a given installation
8) Case Study on analysing the effectiveness of power factor improvement towards improving energy efficiency
9) Case Study on analysing effectiveness of VFD in comparison to Damper control
10) Case study on fuel substitution
11) Experimentation to analyse energy efficiency of VFD based Pumping System
12) Experimentation to analyse energy efficiency of different lamps (T5, T8, CFL, and LED lamp)
13) Experimentation to analyse the effectiveness of power factor improvement based installation
14) Conduction of preliminary audit of any section / facility/ department of engineering institute or nearby industry
15) Conduction of detailed audit of any section / facility/ department of engineering institute or nearby industry

Any other experiment/ case study / tutorial based on the syllabus which will help students to understand the topic/concept.

Term work:

Term work shall consist **of minimum eight tutorials /case studies/ experiments**.

The distribution of marks shall be as follows:

Experiments Performance	: 10 marks
Journal	: 10 marks
Attendance	: 05 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

Oral Examination:

Oral examination will be based on entire syllabus of '**EEC801: Electrical System Design, Management and Auditing' and EEL801**

ELECTRICAL ENGINEERING - SEMESTER-VII						
Course code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEL802	**Measurement and Instrumentation Lab**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		--	**2**		**1**	**1**

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEL802	**Measurement and Instrumentation Lab**	---	---	---	---	--	**25**	**25**	**50**

Course Objectives	1. To get acquainted with analog and digital measurement and instrumentation 2. To illustrate the challenges in real time measurements
Course outcomes	Upon successful completion of this course, the learner will be able to 5. Understand the construction, principle and characteristics of different types of digital measuring instruments 6. Apply the knowledge about different instruments and can identify the best suitable instrument for a required typical measurement. 7. Learn about the digital programming of different types of circuits. 8. Understand the conversion of digital to analog signal and vice versa.

Suggested list of experiments:

1. Experiment demonstrating concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Experiment demonstrating errors in measurements.
3. Measurements of R, L and C using bridge or LCR meter
4. Measurement of very low and high resistance
5. Experiment with Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
6. Measurement of Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
7. Measurement of high voltage /current
8. Isolated and un-isolated measurement
9. Use of Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
10. Use of DSO to capture transients like a step change in R-L-C circuit.
11. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
12. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
13. Analog Signal processing and Digital Signal Processing
14. Measurement and instrumentation using microcontroller boards like Aurdino/pic18F/ MSP430

Any other experiment related to measurement and instrumentation can be conducted.

Note: Students and teachers are encouraged to use the virtual labs whose links are as given below The remote-access to Labs in various disciplines of Science and Engineering is available. Students can conduct online experiments which would help them in learning basic and advanced concepts through remote experimentation.

Virtual Lab Website Reference
1. http://vlab.co.in/broad-area-electrical-engineering
2. http://vlab.co.in/broad-area-electronics-and-communications

Reference books:

1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
4. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer

Term work:

Term work shall consist of minimum eight experiments. The distribution of marks shall be as follows:

Experiments Performance	: 10 marks
Journal	: 10 marks
Attendance	: 05 marks

The final certification and acceptance of term work ensures the minimum passing in the term work.

Oral Examination:

Oral examination will be based on all the laboratory experiments carried out in **EEL802- Measurement and Instrumentation Lab**

ELECTRICAL ENGINEERING - SEMESTER-VIII						
Course Code	Course Name	Teaching scheme (Contact Hours)		Credits Assigned		
EEP801	**Major Project - II**	Theory	Pract./Tut.	Theory	Pract./Tut.	Total
		--	$12^{\$}$	--	6	6

Course code	Course Name	Examination Scheme							
		Theory					Term Work	Oral	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg					
EEP801	**Major Project - II**	--	--	--	--	--	**100**	**50**	**150**

$ indicates work load of Learner (Not Faculty)

Course Objectives	5. To design and develop a moderately complex electrical/electronic/digital circuit with practical applications. 6. To understand basic concepts of circuit design while developing the project. 7. To enable the students to gain hands-on experience independently proposing and implementing the project and thus acquire the necessary confidence to deal with complex electrical/electronic/digital systems.
Course Outcomes	Upon successful completion of this course, the learner will be able to: 10. Identify problems based on societal /research needs. 11. Apply Knowledge and skill to solve societal problems in a group. 12. Develop interpersonal skills to work as member of a group or leader. 13. Draw the proper inferences from available results through theoretical/ experimental/ simulations. 14. Analyse the impact of solutions in societal and environmental context for sustainable development. 15. Use standard norms of engineering practices 16. Excel in written and oral communication. 17. Demonstrate capabilities of self-learning in a group, which leads to life-long learning. 18. Demonstrate project management principles during project work

<u>Guidelines for Assessment of Major Project- II:</u>

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for Major Project- I shall be as below;
  - Marks awarded by guide/supervisor based on log book : 40
  - Marks awarded by review committee : 40
  - Quality of Project report : 20

Review/progress monitoring committee may consider following points for assessment as mentioned in general guidelines. Two reviews shall be conducted based on presentation given by students group based on the following criteria:

<u>Assessment criteria of Major Project-II.</u>

Major Project shall be assessed based on following criteria;

13. Quality of literature survey/ need identification
14. Clarity of Problem definition based on need.
15. Innovativeness in solutions
16. Feasibility of proposed problem solutions and selection of best solution
17. Cost effectiveness
18. Societal impact
19. Innovativeness
20. Cost effectiveness
21. Effective use of skill sets
22. Effective use of standard engineering norms
23. Contribution of an individual's as member or leader
24. Clarity in written communication

Project Report has to be prepared strictly as per University of Mumbai report writing guidelines.

Oral Examination:

Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiner approved by the University of Mumbai. Students should be motivated to publish a paper in Conferences/students competitions based on the work.

Major Project II shall be assessed based on following points:

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication