Course Booklet

4th Year Electrical Engineering

श्रमम् बिना न किमपि साध्यम्

Department of Electrical Engineering

RCC Institute of Information Technology

Approved by AICTE, New Delhi and Affiliated to MAKAUT, W.B.

An ISO 9001 - 2008 & ISO 14001 - 2004 Certified Institute A Unit of RCC Institute of Technology an autonomous Society of Department of Higher Education, Govt. of West Bengal

Table of Content

About the Department

The Department of Electrical Engineering (which is now accredited by National Board of Accreditation (NBA), New Delhi) started its journey in the year 2009 under RCCIIT and the first batch of students graduated in the year 2013. It is situated in the ground floor of the new campus of the Institute. The department offers Electrical Engineering (EE) undergraduate program that augments the liberal education to undergraduates and imparts well understanding of the subject, Electrical Engineering and its different aspects built on a foundation of Science, Mathematics, Computation, Engineering and Technology. Admissions for UG program in this department require a valid rank of WBJEE/AIEEE which is monitored through the Institutional Admission Committee following the guidelines of the Maulana Abul Kalam Azad University of Technology, previously known as the West Bengal University of Technology. The department also take admission under lateral entry scheme from the merit list of JELET conducted by West Bengal Joint Entrance Examinations Board. The present intake of this department is 60. The department has highly qualified and experienced faculty and staff members. The Department has well modernized class rooms, Faculty rooms and possesses exclusive laboratories as per university course curriculum. Apart from the academics, students are also encouraged for different extra-curricular activities like quizzes, seminars, workshops etc.

Faculty Profile

Dr. Shilpi Bhattacharya (HoD)

Associate Professor

Power Electronics, Drives

Dr. Debasish Mondal

Professor

Control System, Field Theory

Dr. Alok Kole

Professor

AI ML, Control System

Dr. Dipankar Santra

Associate Professor

Measurement, Machine

Mr. Budhaditya Biswas (PC)

Assistant Professor

Power System

Mr. Nijam Uddin Molla

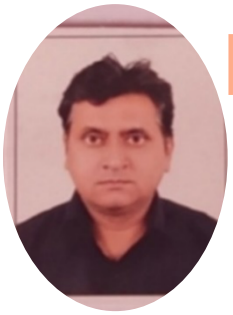
Assistant Professor

Electric Machine

Mr. Sarbojit Mukherjee

Assistant Professor

Power Electronics, Drives



Mr. Subhasish Banerjee

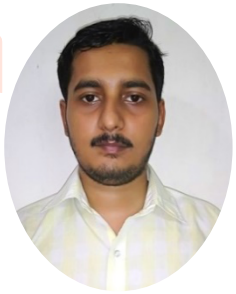
Assistant Professor

Non-Conventional Energy

Dr. Shilpi Bhattacharya (HoD)

Assistant Professor

Microcontroller, FPGA



Non Teaching Staff Profile

Mr. Ashim Biswas

Lab Technician

Basic Electrical, Machine

Mr. Soumitra Dey

Lab Technician

Thermal Power, Power System

Mr. Rajesh Mahato

Lab Technician

Control System, Circuit Theory

Mr. Sumit Mukherjee

Technical Assistant

Power Electronics, Drives

Mr. Abir Sen

General Assistant

Vision of the Program (Electrical Engineering)

To create world class professionals who are globally competitive, capable of using and developing state-of-the-art technologies along with research and innovation in EE and allied fields.

Mission of the Program (Electrical Engineering)

M1: To provide education to the students that will enable them to meet the current and future needs of EE and possess diverse capabilities to pursue their careers successfully.

M2: To be research and innovation oriented so as to investigate and develop new technologies.

M3: To remain constantly agile to the needs of industry, environment and society so as catered to the needs of the nation and the global community.

Program Outcome (POs)

Engineering Graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

The graduate will posses:

- Basic understanding of core electrical engineering built on foundation of physical science, mathematics, computing, and technology so as to pursue successful career/higher studies in Electrical Engineering.
- Broad based knowledge of Electrical Engineering suitable for research, development and innovation to meet diverse and multidisciplinary needs of industry and society.
- Adequate professional skills, to be analytical and logical so that they can quickly adapt to new work environment, assimilate information and solve challenging problems.
- Self-learning capability, leadership qualities with strong communication skills and working in teams.
- Capacity to be productive with ethical values, conscious about social and environmental issues with lifelong learning attitude.

Program Specific Outcome (PSOs)

At the end of the program, the students

PSO1: Proficiency in use of software & hardware required to practice Electrical engineering profession.

PSO2: Proficiency in developing wind & solar hybrid power generating systems.

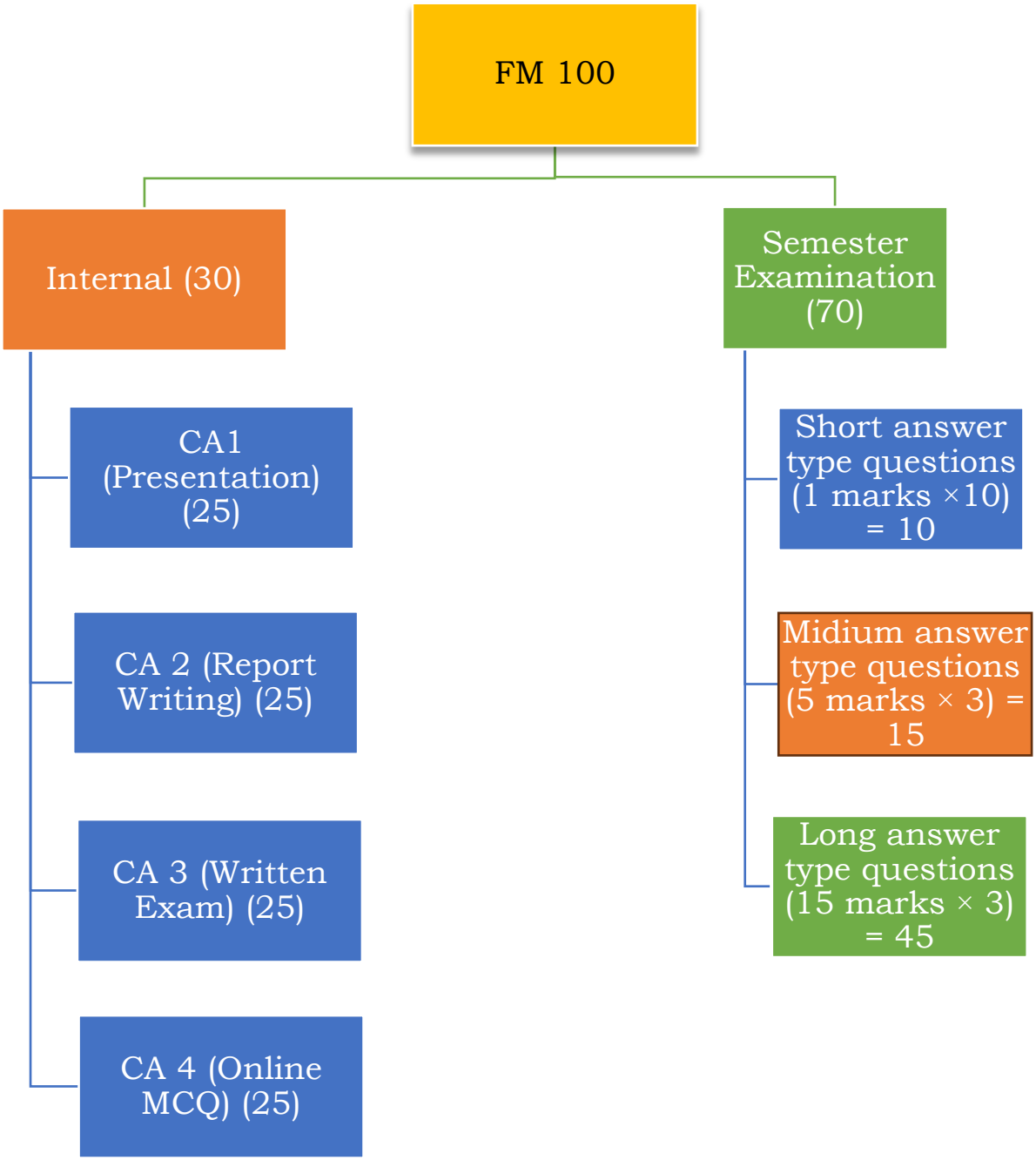
PSO3: Development of wireless control & automation and real time simulations for prototypes.

Correlation between Program Educational Objectives (PEOs) and Mission of the Department of Electrical Engineering, RCCIIT

PEO No.	Statement	M1	M2	M3
PEO 1	Basic understanding of core electrical engineering built on foundation of physical science, mathematics, computing, and technology so as to pursue successful career/higher studies in Electrical Engineering.	3	3	3
PEO 2	Broad based knowledge of Electrical Engineering suitable for research, development and innovation to meet diverse and multidisciplinary needs of industry and society.	3	3	3
PEO 3	Adequate professional skills, to be analytical and logical so that they can quickly adapt to new work environment, assimilate information and solve challenging problems.	2	3	3
PEO 4	Self-learning capability, leadership qualities with strong communication skills and working in teams.	3	3	2
PEO 5	Capacity to be productive with ethical values, conscious about social and environmental issues with lifelong learning attitude.	3	2	3

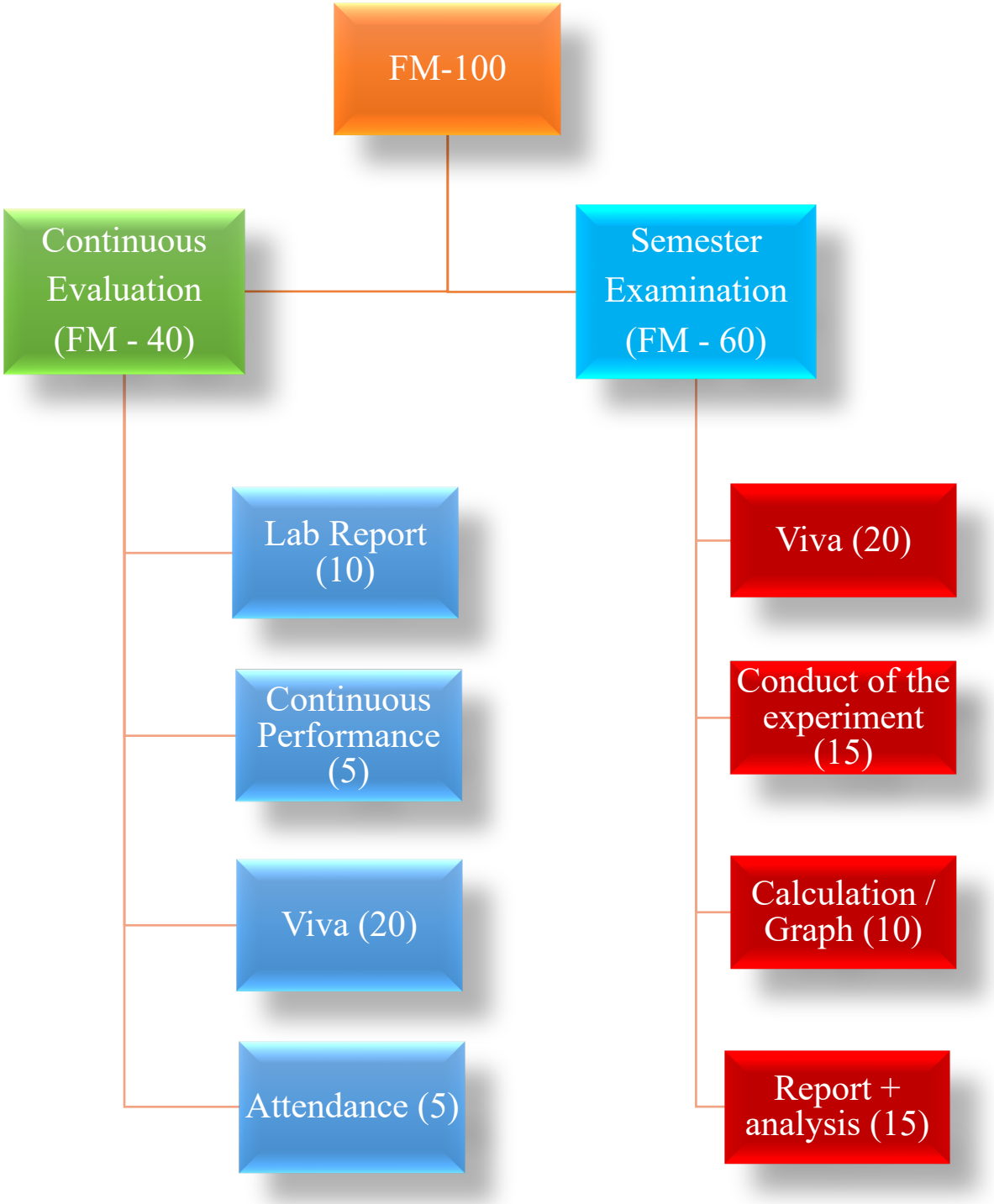
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

Marks Division for Theory Examination



University takes 4 **Continuous Assessments (CA)** out of 25 and they scale it within 30 marks in the final result.

Marks Division for Practical Examination



University takes 2 **Practical Continuous Assessment (PCA)** during the semester.

Course Structure

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits

Range of credits:

A range of credits from 150 to 160 for a student to be eligible to get B.Tech Degree in Engineering. A student will be eligible to get B.Tech Degree with Honours, if he/she completes an additional 20 credits. These could be acquired through Massive Open Online Courses (MOOCs).

MOOCs for B. Tech Honours:

The additional 20 credits (for obtaining B. Tech with Honours) are to be gained through MOOCs. The complete description of the MOOCs relevant for the first year course are given in **Annexure-I**. The courses for subsequent years of study will be posted subsequently.

Guidelines regarding Mandatory Induction Program for the new students:

All concerned are requested to follow the guidelines given in **Annexure-II** concerning Mandatory Induction Program. The colleges/ Institute may also refer to the AICTE Model Curriculum for Undergraduate Degree Courses in Engineering & Technology

Mandatory Additional Requirement for earning B. Tech Degree:

All concerned are requested to follow the guidelines in **Annexure-III** concerning Mandatory Additional Requirements.

Group division:

Group-A:

Chemistry based subjects:

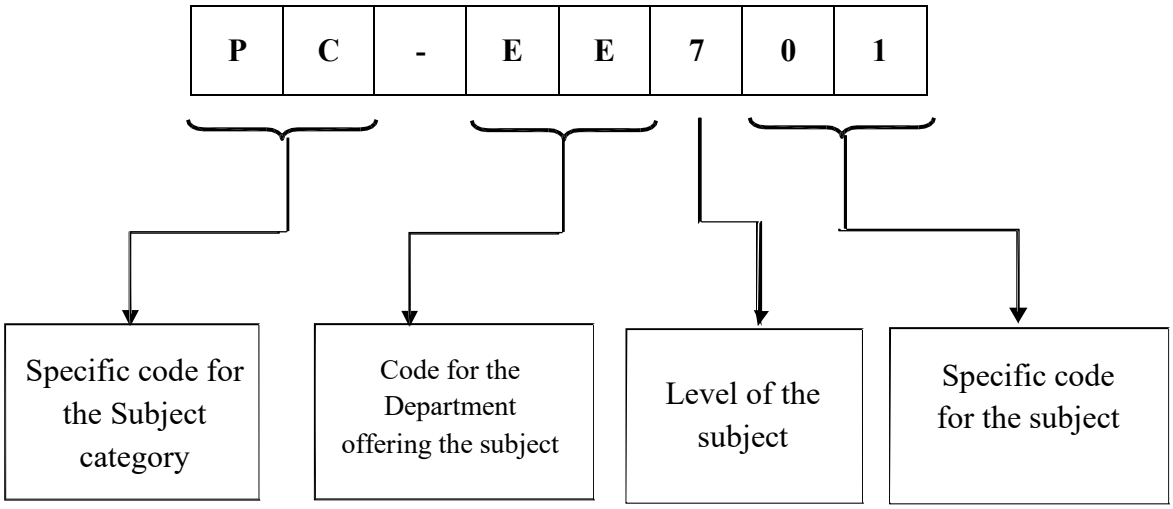
[Bio-Technology, Food Technology, Leather Technology, Textile Technology, Ceramic Technology, Chemical Engineering, and any other Engineering that chooses to be Chemistry based] + Physics based subjects: [Mechanical Engineering, Production Engineering, Civil Engineering, Automobile

Engineering, Marine Engineering, Apparel Production Engineering, Computer Science & Engineering, Information Technology.]

Group-B:

All Physics based subjects which are also Electrical & Electronics based [**Electrical Engineering**, Electronics & Communication Engineering, Applied Electronics & Instrumentation Engineering, Power Engineering, Electrical & Electronics Engineering, Bio- Medical Engineering, Instrumentation & Control Engineering]

Subject Numbering Scheme:



List of Codes for Subject Category	
Code	**Category Name**
BS	Basic Science Courses
E	Engineering Science Courses
HM	Humanities and Social Sciences including Management courses
PC	Professional core courses
PE	Professional Elective courses
OE	Open Elective courses
MC	Mandatory courses
PW	Project

4th Year First Semester

Theory

Sl. No.	CODE	Paper	Contact periods Per week			Total Contact Hrs	Credits
			L	T	P		
1	PC-EE 701	Electric Drive	3	0	0	3	3
2	PE-EE 701	A. Control system Design B. Electrical Energy conservation & Auditing C. Power generation economics	3	0	0	3	3
3	OE-EE701	A. Artificial intelligence B. Internet of things C. Computer graphics	3	0	0	3	3
4	OE-EE702	A. Embedded system B. Digital image processing C. Computer network	3		0	3	3
5	HM-EE701	Principle of Management	3	0	0	3	3
		TOTAL OF SEMESTER:				15	15

Practical

Sl. No.	CODE	Paper	Contact periods Per week			Total Contact Hrs	Credits
			L	T	P		
1	PC-EE 791	Electric Drive laboratory	0	0	2	2	1
2	PW-EE 781	Project stage-I	0	0	4	4	2
3	PW-EE782	Seminar	0	0	0	0	1
		Total of Practical / Sessional				06	04
TOTAL OF SEMESTER:						**21**	**19**

4th Year Second Semester

Theory

Sl. No.	CODE	Paper	Contact periods Per week			Total Contact Hrs	Credits
			L	T	P		
1	PC-EE 801	Utilization of Electric Power	3	0	0	3	3
2	PE- EE 801	A. Line –commutated and active PWM rectifiers B. Power system dynamics & control C. Advanced Electric Drives D. Industrial Automation and Control	3	0	0	3	3
3	OE-EE 801	A. Soft computing Techniques B. Biomedical Instrumentation. C. Introduction to Machine learning E. Sensors and Transducers	3	0	0	3	3
		TOTAL OF SEMESTER:				**9**	**9**

Practical

Sl. No.	CODE	Paper	Contact periods Per week			Total Contact Hrs	Credits
			L	T	P		
1	PC-EE 881	Project Stage 2	0	0	16	16	8
		Total of Practical / Sessional				16	08
TOTAL OF SEMESTER:						**25**	**17**

Fourth Year First Semester Articulation Matrix

Sl. No.	NBA Code	Subject Code	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8	CO 9	CO 10	CO 11	CO 12	PSO 1	PSO 2	PSO 3
1	C401	PC-EE 701	3.0	3.0	1.7	1.4	2.5	2.5	1.3	1.0	2.5	2.0	2.0	2.2	2.8	1.0	1.7
2	C402	PE-EE 701C	1.8	2.4	2.8	1.5	2.5	1.0	2.5	1.5	2.5	0.0	0.0	2.3	2.2	1.5	2.0
3	C403	OE-EE-701B	3.0	2.7	1.8	1.8	2.2	2.5	1.7	1.0	2.6	1.6	2.0	2.2	2.8	1.0	1.3
4	C404	OE-EE 702C	3.0	3.0	3.0	2.5	2.8	2.3	2.5	1.8	1.5	2.0	2.0	3.0	2.0	1.8	2.2
5	C405	HM-EE 701	3.0	0.0	1.0	0.0	1.0	2.0	3.0	0.0	1.0	1.8	3.0	0.0	1.5	1.7	2.3
6	C406	PC-EE 791	3.0	3.0	2.0	1.4	3.0	1.6	1.0	1.0	2.3	1.5	3.0	1.4	3.0	1.7	2.8
7	C407	PW-EE 781	2.8	2.7	2.4	1.4	2.3	1.3	1.7	2.0	2.7	3.0	1.5	2.0	3.0	1.7	2.8
8	C408	PW-EE 782	2.8	2.6	2.0	1.4	0.0	1.5	0.0	0.0	0.0	2.7	0.0	0.0	2.5	1.8	2.3

Fourth Year Second Semester Articulation Matrix

Sl. No.	NBA Code	Subject Code	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8	CO 9	CO 10	CO 11	CO 12	PSO 1	PSO 2	PSO 3
1	C409	PC-EE 801	3.0	2.5	2.0	1.4	3.0	1.6	1.0	1.0	2.3	1.5	2.0	1.4	1.3	2.3	1.0
2	C410	PE- EE 801D	3.0	2.3	1.7	2.0	3.0	1.0	0.0	0.0	1.0	0.0	2.0	0.0	1.7	1.7	3.0
3	C411	OE-EE 801D	2.85	2.25	1.57	2.18	2.07	1.32	1.33	0.00	0.00	2.00	1.85	1.40	1.60	2.38	2.00
4	C412	PW-EE 881	2.3	2.5	2.2	1.8	2.3	1.3	1.7	2.0	2.0	2.3	1.5	2.0	2.8	1.5	2.5

Name of the course	**ELECTRIC DRIVE**
Course Code: PC-EE 701	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Course Objective:

1.	To understand basic concept, classification and principle of operation of Electric Drive.
2.	To understand methods of starting and braking of Electric Drive.
3.	To understand methods of control of speed of DC and AC Drives.
4.	To solve problem related to Electric Drive.

Pre-Requisite:

Basic Electrical Engineering (ES-EE-101)
Electric Machine-I (PC-EE-401)
Electric Machine-II(PC-EE-501)

Course Outcomes:

CO1	Classify the types of Electric Drives and estimate motor power ratings.
CO2	Classify types of starting and braking in electric motors and determine energy losses in transients.
CO3	Compare speed control methods in DC motors.
CO4	Examine and Compare speed control methods in Induction motors and Synchronous motors.
CO5	Devise Electric drive techniques to control motors.
CO6	Design modern electric drive systems for optimum performance.

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	0	1	0	1	0	0	0	0	1	0	0	0
CO2	3	3	2	1	2	0	2	0	0	0	0	1	0	0	0
CO3	3	3	1	1	3	0	1	0	0	0	0	3	2	1	0
CO4	3	3	1	1	3	0	1	0	0	0	0	3	3	1	1
CO5	3	3	2	1	3	2	1	1	2	2	0	2	3	1	1
CO6	3	3	3	3	3	3	2	1	3	2	2	3	3	1	3
Avg	**3.00**	**3.00**	**1.67**	**1.40**	**2.50**	**2.50**	**1.33**	**1.00**	**2.50**	**2.00**	**2.00**	**2.17**	**2.75**	**1.00**	**1.67**

Detail Syllabus:

Unit	Content	Hrs
1	Electric Drive: Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multi- quadrant operation of drives. Load equalization.	5
2	Motor power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.	5
3	Stating of Electric Drives: Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time, Energy relation during stating. Methods to reduce the Energy loss during starting. Braking of Electric Drives: Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking,	6
4	DC motor drives: Modeling of DC motors, State space modeling, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor	8

5	Induction motor drives: Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.	6
6	Synchronous motor drives: Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.	5
	Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive Industrial application: Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.	5

Text books:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH
3. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication

Reference books

1. Electric motor drives, R. Krishnan, PHI
2. Modern Power Electronics & Ac drives, B.K. Bose, Pearson Education.
3. Electric Motor & Drives. Austin Hughes, Newnes.

Name of the course	**POWER GENERATION ECONOMICS**
Course Code: PE-EE 701C	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Course Objective:

1.	To understand the basics of economics of Power generation.
2.	To understand different methods of Tariff.
3.	To understand the optimization with unit commitment in power system.
4.	To understand the principle of economic load dispatch.
5.	To understand the method of state estimation and load forecasting in a power system.

Pre-Requisite:

1.	Electric Power system-I (PC-EE-502)
2.	Electric Power system-II (PC-EE-601)

Course Outcomes:

CO1	Explain the different terms e.g. load factor etc for economics of generation
CO2	Apply different types of tariffs for electricity pricing
CO3	Optimize the operation of power system with unit commitment
CO4	Determine generation levels such that the total cost of generation becomes minimum for a defined level of load
CO5	Determine the state of the system given by the voltage magnitudes and phase angles at all
CO6	Predict the power or energy needed to balance the supply and load demand at all the times

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	-	-	3	-	3	-	2	-	-	-	3	-	2
CO2	1	3	3	2	2	-	-	-	-	-	-	-	1	2	1
CO3	2	2	3	1	-	-	-	2	-	-	-	3	2	-	3
CO4	3	2	2	-	3	1	-	1	-	-	-	2	-	1	-
CO5	2	-	3	2	-	-	2	-	-	-	-	2	3	1	2
CO6	1	2	-	1	2	1	-	-	3	-	-	2	2	2	2
Avg	1.83	2.40	2.75	1.50	2.50	1.00	2.50	1.50	2.50	0.00	0.00	2.25	**2.20**	**1.50**	**2.00**

Detail Syllabus:

Unit	Content	Hrs
1	Economics of Generation: Cost of power generation- Thermal, Hydro and Nuclear. Types of Consumers in a distribution system- Domestic, Commercial, Industrial etc. Concept of load factor, plant capacity factor, plant use factor, diversity factor, demand factor. Choice of size and number of generation units.	7
2	Tariff: Block rate, flat rate, two part, maximum demand, Power factor and three part tariffs. Subsidization and Cross subsidization. Availability tariff of generation companies. Pool tariff of transmission companies. Availability based tariff (ABT).	8
3	Unit Commitment: Constraints in Unit Commitment, Spinning reserve, Thermal unit constraints, Hydro constraints, Must run, Fuel constraints. Unit commitment solution methods,	7
4	Economic Dispatch: Transmission loss formulae and its application in economic load scheduling. Computational methods in economic load scheduling. Active and reactive power optimization	8
5	State Estimation and load forecasting in power system: Introduction, state estimation methods, concept of load forecasting, load forecasting technique and application in power system.	8

Text books:

1. Economic operation of Power System, L.K. Kirchmayar Wiely India Pvt. Ltd, 2009
2. Power system Analysis, operation & control, A. Chakrabarty & S. Haldar, PHI, 2010.
3. Modern power system analysis, D.P. Kothari & I.J. Nagtrath, Tata McGraw Hill, 2007.

Reference books

1. Power generation operation & control, A.J. Wood & B.F. Wollenberg, G.B. Sheble, Wiley, 2013
2. Operation and control in power system, P.S.R. Murthy, BSP Publication. 2009

Name of the course	**INTERNET OF THINGS**
Course Code: OE-EE-701B	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Course Objective:

1.	To understand the terminology, technology and its applications
2.	To understand the concept of M2M (machine to machine) with necessary protocols
3.	To learn the Python Scripting Language which is used in many IoT devices.
4.	To understand the Raspberry PI platform, that is widely used in IoT applications.
5.	To understand the implementation of web based services on IoT devices.

Pre-Requisite:

1.	Programming for problem solving (ES-CS201)

Course Outcomes:

CO1	understand the terminology, technology and its applications
CO2	understand the concept of M2M (machine to machine) with necessary protocols
CO3	learn the Python Scripting Language which is used in many IoT devices.
CO4	Implement the Raspberry PI platform, that is widely used in IoT applications.
CO5	understand the implementation of web based services on IoT devices.
CO6	Design complete IoT system

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	0	0	0	1	0	0	1	0	2	0	1	1
CO2	3	3	1	1	2	2	2	0	2	2	0	2	3	0	1
CO3	3	3	2	0	2	0	1	0	3	1	0	2	3	0	2
CO4	3	3	2	1	2	0	2	0	2	0	0	2	3	0	1
CO5	3	2	2	2	2	0	2	0	3	1	0	2	2	1	1
CO6	3	2	3	3	3	3	2	1	3	3	2	3	3	1	2
Avg	3.00	2.67	1.83	1.75	2.20	2.50	1.67	1.00	2.60	1.60	2.00	2.17	**2.80**	**1.00**	**1.33**

Detail Syllabus:

Unit	Content	Hrs
1	Introduction to Internet of Things: Definition and characteristics of IoT, Physical design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs, IoT enabled technologies – Wireless sensor networks, Cloud computing, Big data analytics, Communication protocols, Embedded systems, IoT levels and templates, Domain specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.	8
2	IoT and M2M: Software defined networks, network function virtualization, difference between SDN and NFV for IoT. Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER	6
3	Introduction to Python: Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling. Python packages - JSON, XML, HTTP Lib, URL Lib, SMTP Lib.	8
4	IoT Physical Devices and Endpoints: Introduction to Raspberry PI - Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.	8
5	IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs. Webserver – Web server for IoT, Cloud for IoT, Python web application framework. Designing a RESTful web API	8

Text books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2016.
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Pearson Education, 2017.
4. Internet of Things, K.G. Srinivasa , G.M. Siddesh, R.R. Hanumantha, CENGAGE Leaning India, 2018

Reference books

1. Internet of Things (A Hands-on-Approach), Arshdeep Bahga and Vijay Madisetti, VPT, 2014.
2. Internet of Things: Architecture and Design Principles, Raj Kamal , McGraw Hill Education, 2017.

Name of the course	**COMPUTER NETWORK**
Course Code: OE-EE 702C	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:

1.	To understand the fundamental concepts of data communication and computer networking.
2.	To understand different layers of OSI, TCP/IP model in networking.

Pre-Requisite

1.	Data Structure and Algorithm (OE-EE 501A)
2.	Operating System

Course Outcomes:

CO1	Describe the fundamental concept of computer networking, data communication and learn its components.
CO2	Explain the concept of functions of each layer of the OSI model and learn about TCP/IP.
CO3	Identify the different types of network topologies, protocols, networking devices and make concepts about their functions within a network.
CO4	Simplify building the skills of subnetting and differentiate among different types of routing protocol.
CO5	Justify the different system component parts of the network and apply principles of congestion control
CO6	Develop an expertise in some specific areas of networking to implement different schemes to learn about security and maintenance of individual networks

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	0	1	0	0	3	1	0	2
CO2	3	3	3	2	2	2	2	0	1	0	0	3	2	0	2
CO3	3	3	3	2	3	2	2	1	1	0	0	3	2	1	2
CO4	3	3	3	2	3	2	3	2	1	1	0	3	2	1	2
CO5	3	3	3	3	3	3	3	1	2	2	1	3	2	2	2
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	**3.00**	**3.00**	**3.00**	**2.50**	**2.83**	**2.33**	**2.50**	**1.75**	**1.50**	**2.00**	**2.00**	**3.00**	**2.00**	**1.75**	**2.17**

Detail Syllabus:

Unit	Content	Hrs
1	Overview of Data Communication and Networking: Introduction, Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.	6
2	Physical Level: Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit Switching: time division & space division switch, TDM bus; Telephone Network.	4
3	Data link Layer: Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, HDLC. Medium Access sub layer: Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief).	10

4	Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : IP addressing, sub netting; Routing : techniques, static vs. dynamic routing , Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPV6. Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm	12
5	Application Layer: Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls. Modern topics: ISDN services & ATM, DSL technology, Cable Modem: Architecture and operation in brief. Wireless LAN: IEEE 802.11, Introduction to blue-tooth.	8

Text books:

1. Data Communications and Networking , A. Forouzan , TMH, 2004
2. Computer Networks , A. S. Tanenbaum, Pearson Education, 2003.
3. Data and Computer Communications (5th Ed.), W. Stallings, Pearson Education, 2017.

Reference books

1. Communication Networks, Leon, Garica, Widjaja, McGraw Hill, 2017.
2. High performance Communication Networks, Walrand, Elsvier India, 2004.
3. Internetworking with TCP/IP, vol. 1, 2, 3, Comer, Pearson Education, 2000.

Name of the course	**PRINCIPLE OF MANAGEMEENT**
Course Code: HM-EE 701	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Course Objectives:

1.	To understand basic concept and approaches to management.
2.	To understand planning and decision making processes. .
3.	To understand organizational design and structure.
4.	To understand various aspects of leadership.

Pre Requisite:

1.	English (HM- HU 201)

Course Outcomes:

CO1	explain the concepts and approaches of management.
CO2	demonstrate the roles, skills and functions of management.
CO3	diagnose and solve organizational problems.
CO4	identify the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.
CO5	apply different methods of Customer, Operation and Technology management.
CO6	acquire skills of good leader in an organization.

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	0	0	0	0	0	0	0	0	3	0	0	0	0	3
CO2	0	0	0	0	0	0	3	0	0	1	0	0	0	0	3
CO3	0	0	1	0	1	0	0	0	0	2	0	0	2	0	3
CO4	0	0	0	0	0	0	0	0	0	2	0	0	0	1	1
CO5	0	0	0	0	0	2	0	0	1	1	3	0	1	2	2
CO6	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Avg	**3.00**	**0.00**	**1.00**	**0.00**	**1.00**	**2.00**	**3.00**	**0.00**	**1.00**	**1.80**	**3.00**	**0.00**	**1.50**	**1.67**	**2.33**

Detail Syllabus:

Unit	Content	Hr
1	Concept & approaches to management: Meaning & Definition of the term Management, Management as a Science or an Art, Management as a Profession, Management as a Process, Difference between Management & Administration; Levels of Management, Roles of a Manager, Quality of a good Manager, Significance of Management, Limitations of Management, Business Environment and its interaction with Management. Approaches to Management – Classical, Neo-classical and Modern Contributors to Management Thought – Taylor and Scientific Theory, Fayol's and Administrative Theory, Peter Drucker and Management Thought. Various Approaches to Management (i.e. Schools of Management Thought) Indian Management Thought	3
2	Planning & decision making: Planning: Meaning, Definition, Process, Types, Principles, Significance & Limitations of Planning; Strategic Planning – Meaning & Process, MBO – Meaning, Process and Requirements for Implementation, Planning Premises – Meaning & Types, Forecasting – Meaning & Techniques. Decision Making – Meaning, Types, Process, Significance & Limitations	8
3	Organization design & Structure: Organization – Meaning, Process, Principles, Organization Structure – Determinants and Forms: Line, Functional, Line & Staff, Project, Matrix and Committees; Formal and Informal Organization; Departmentation – Meaning and Bases; Span of Control – Meaning and Factors Influencing; Authority, Responsibility and Accountability; Delegation – Meaning, Process; Principles; Centralization and Decentralization – Meaning; Degree of Decentralization; Difference between Delegation and Decentralization.	5

4	Directing: Motivation – Meaning , Definition, Significance & Limitations; Financial and non-financial incentives of Motivation Leadership - Meaning, Definition, Significance of Leadership, Leadership styles Type, Process and Barriers of Communication, Strategies to overcome the Barriers.	5
5	Customer Management – Market Planning & Research, Marketing Mix, Advertising & Brand Management. Operations & Technology Management – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.	5

Text books:

1. Essentials of Management. H. Koontz and H. Weihrich , 7th Edition, Tata McGraw Hill
2. Principles of Management, Premvir Kapoor, Khanna Publishing House, 2019
3. Principles of Management - Text and Cases, Dipak Kumar Bhattacharyya. Pearson Education India, 2011.

Reference books

1. Management-Text & Cases, V.S.P Rao & Hari V. Krishna, Excel Books, 2005
2. Principles of Management, T. Ramaswami, Himalaya Publishing House, 2014
3. Management of Technology and Operations, R. Ray Gehani, Wiley, 1998

Name of the course	**ELECTRIC DRIVE LABORATORY**
Course Code: PC-EE 791	Semester: 7th
Duration: 6 months	Maximum marks:100
Teaching Scheme	Examination scheme:
Theory: 0 hr/week	Continuous Internal Assessment:40
Tutorial: 0 hr/week	External Assessment: 60
Practical: 2 hrs/week	
Credit Points:1	

Course Outcomes:

CO1	Demonstrate the operation of DC/AC Drives.
CO2	Simulate and Analyze voltage source inverter fed and current source inverter fed AC Drives.
CO3	Recall and Demonstrate operation of modern frequency control AC Drive.
CO4	Design control strategy and Simulate a PMSG drive.
CO5	Simulate and Demonstrate h/w model of Regenerative/Dynamic braking of DC/AC motor.
CO6	Design and Simulate sample DC/AC drive system.

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	0	3	0	0	0	2	1	0	1	0	0	2
CO2	3	3	2	1	3	1	0	0	2	1	0	1	0	0	3
CO3	3	3	3	1	3	2	1	0	2	2	0	2	3	0	3
CO4	3	3	1	1	3	2	0	0	2	1	0	0	3	1	3
CO5	3	3	2	1	3	1	0	1	3	1	0	1	3	1	3
CO6	3	3	3	3	3	2	1	1	3	3	3	2	3	3	3
Avg	**3.00**	**3.00**	**2.00**	**1.40**	**3.00**	**1.60**	**1.00**	**1.00**	**2.33**	**1.50**	**3.00**	**1.40**	**3.00**	**1.67**	**2.83**

Detail Syllabus:

1.	Study of speed control of Thysistor controlled DC Drive.
2.	Study of speed control of Chopper fed DC Drive
3.	Study of speed control of single phase motor using TRIAC.
4.	Study of PWM Inverter fed 3 phase Induction Motor control using software.
5.	Study of VSI / CSI fed Induction motor Drive using software.
6.	Study of V/f control of 3phase Induction motor drive.

7.	Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.
8.	Study of Regenerative / Dynamic braking operation for DC Motor - Study using software.
9.	Study of Regenerative / Dynamic braking operation of AC motor - study using software.
10.	Study of PC/PLC based AC/DC motor control operation.

Name of the course	**Project Stage - I**
Course Code: PW-EE 781	Semester: 7th
Duration: 6 months	Maximum marks:100
Teaching Scheme	Examination scheme:
Theory: 0 hr/week	External Assessment: 100
Tutorial: 0 hr/week	
Practical: 4 hrs/week	
Credit Points:2	

Course Outcomes:

CO1	Analyze the problem, formulation and solution of the selected project
CO2	Develop solutions for contemporary problems using modern tools for sustainable development.
CO3	Demonstrate ethical and professional sustainability while working in a team and communicate effectively for the benefit of the society.
CO4	Understand the engineering, finance and management principles.
CO5	Design engineering solutions to complex problems utilising a systems approach.
CO6	Communicate with engineers and the community at large in written an oral forms.

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1									0	0	2
CO2	3	3	3	2	3	1	2		3	3	2	3	0	0	3
CO3	3	3	3	1		1	1	3	2	3	1	3	3	0	3
CO4	3	1	3	2	1						1	2	3	1	3
CO5	3	3			3	2	2	2	3			1	3	1	3
CO6	2	3	2	1		1		1		3	2	1	3	3	3
Avg	**2.83**	**2.67**	**2.40**	**1.40**	**2.33**	**1.25**	**1.67**	**2.00**	**2.67**	**3.00**	**1.50**	**2.00**	**3.00**	**1.67**	**2.83**

Name of the course	**Seminar**
Course Code: PW-EE 782	Semester: 7th
Duration: 6 months	Maximum marks:100
Teaching Scheme	Examination scheme:
Theory: 0 hr/week	External Assessment: 100
Tutorial: 0 hr/week	
Practical: 0 hrs/week	
Credit Points:1	

Course Outcomes:

CO1	Improve their knowledge and skills relevant to their areas of specialization.
CO2	Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.
CO3	Acquire knowledge and skills to compete in the job market with this experience and exposure.
CO4	Acquire awareness on latest technology and current trends in the field of Electrical Engineering
CO5	Participate in discussions for enhancement of knowledge
CO6	Able to write technical document and present technical reports

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1									0	0	1
CO2	3	3	1	2	3	1	2		3	3	2	1	0	2	3
CO3			3	1		2	1	3	1	2	1	3	3	0	3
CO4	3	1	3	2	1						2	2	2	1	1
CO5		3			3	2	2	2	3			2	2	1	3
CO6	2	3	2	1		1		1		3	2	1	3	3	3
Avg	**2.75**	**2.60**	**2.00**	**1.40**	**0.00**	**1.50**	**0.00**	**0.00**	**0.00**	**2.67**	**0.00**	**0.00**	**2.50**	**1.75**	**2.33**

Name of the course	**UTILIZATION OF ELECTRIC POWER**
Course Code: PC-EE 801	Semester: 8th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	To unterstand basic principle of illumination and good lighting practices
2.	To understand the method of Electric heating, Welding and Electrolytic processes.
3.	To understand the concepts of Electrical traction systems .
4.	To solve numerical problems on the topics studied.

Pre-Requisite:

1.	Electric Machine (PC-EE-401, PC-EE-501)
2.	Control System (PC-EE-503)
3.	Power Electronics (PC-EE-504)

Course Outcomes:

CO1	Explain the fundamentals of illumination and different lighting schemes.
CO2	Explain the fundamentals of illumination and different lighting schemes.
CO3	Able to select appropriate lighting, heating and welding techniques for specific applications.
CO4	Apply different electrolysis process for different applications
CO5	Explain the principle of different aspect of Electric traction and control of traction
CO6	Able to solve the numerical problem related to tractive effort,speed time curve, velocity of mail line and su urban railways

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	0	3	0	0	0	2	1	0	1	0	0	0
CO2	3	2	2	1	3	1	0	0	2	1	0	1	1	2	0
CO3	3	2	3	1	3	2	1	0	2	2	0	2	1	0	1
CO4	3	2	1	1	3	2	0	0	2	1	0	0	1	1	0
CO5	3	3	2	1	3	1	0	1	3	1	0	1	0	3	1
CO6	3	3	3	3	3	2	1	1	3	3	2	2	2	3	1
Avg	**3.00**	**2.50**	**2.00**	**1.40**	**3.00**	**1.60**	**1.00**	**1.00**	**2.33**	**1.50**	**2.00**	**1.40**	**1.25**	**2.25**	**1.00**

Detail Syllabus:

Unit	Content	Hrs
1	**Electric Traction :** Requirement of an ideal traction system, Supply system for electric traction, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed), Mechanism of train movement (energy consumption, tractive effort during acceleration, tractive effort on a gradient, tractive effort for resistance, power & energy output for the driving axles, factors affecting specific energy consumption, coefficient of adhesion). Electric traction motor & their control: Parallel and series operation of Series and Shunt motor with equal and unequal wheel diameter, effect of sudden change of in supply voltage, Temporary interruption of supply, Tractive effort and horse power. Use of AC series motor and Induction motor for traction. Traction motor control: DC series motor control, Multiple unit control, Braking of electric motors, Electrolysis by current through earth, current collection in traction system, Power electronic controllers in traction system.	10
2	**Electric Lighting:** Definition of terms; laws of illumination; Luminaries; Lighting requirements; Illumination levels; lamp selection and maintenance; Lighting schemes, calculations & design – Interior lighting – industrial, Factory, residential lighting; Exterior lighting - Flood, street lighting, lighting for displays and signaling - neon signs, LED-LCD displays beacons and lighting for surveillance;Energy Conservation codes for lighting; lighting controls – daylight sensors and occupancy sensors; controller design.	8

3	**Electric Heating :** Advantages of electrical heating, Heating methods, Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances and thermostat control circuit, Induction heating;	8
4	**Electric Welding:** Advantages of electric welding, Welding methods, Principles of resistance welding, types –spot, projection seam and butt, welding and welding equipment used , Principle of arc production, electric arc welding, characteristics of arc, carbon arc, metal arc, hydrogen arc welding and their applications, Power supply required ,Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper, Introduction to TIG, MIG welding	8
5	**Electrolytic processes:** Needof electro-deposition, Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing, Equipment and accessories for electroplating, Factors affecting electro-deposition, Principle of galvanizing and its applications, Principle of anodising and ist applications,Electroplating on non-conducting materials , Manufacture of chemicals by electrolytic process and electrolysis process.	6

Text books:

1. Generation Distribution and Utilization of Electrical Energy, C.L. Wadhawa, New Age International Publishers, 2015
2. Art and Science of Utilization of Electrical Energy, H. Partab, Dhanpat Rai & co, 2017
3. Utilisation of Electric Energy, E.Openahaw Taylor, Universities press, 1981

Reference books:

1. Generation and Utilization of Electrical Energy by S. Sivanagaraju, Pearson, 2010.
2. Utilization of Electrical Energy by J. B. Gupta, Rajeev Manglik, Rohit Manglik, Kataria Publications, 2012.

Name of the course	**INDUSTRIAL AUTOMATION AND CONTROL**
Course Code: PE-EE 801D	Semester: 8th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	To understand Industrial automation and control.
2.	To understand the different control modes.
3.	To understand advance industrial control strategies.
4.	To understand the Programmable Logic Controller and distributed control system.

Pre-Requisite:

1.	Control System (PC-EEE-503)

Course Outcomes:

CO1	Able to explain the basic structure of Industrial Automation and Control
CO2	Able to classify different types of control actions of controllers
CO3	Able to analyze control strategies of different processes of industry
CO4	Able to illustrate the construction and use of different types of Actuators and Control valves.
CO5	Able to configure Programmable Logic Controller (PLC) for Industrial maintenance and control
CO6	Able to use advance control systems like DCS and SCADA in Industrial Automation & control

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	0	0	0	0	0	0	0	0	0	1	1	3
CO2	3	1	1	0	0	0	0	0	0	0	0	0	1	1	3
CO3	3	3	2	2	3	1	0	0	1	0	2	0	2	2	3
CO4	3	3	2	2	3	1	0	0	1	0	2	0	2	2	3
CO5	3	3	2	2	3	1	0	0	1	0	2	0	2	2	3
CO6	3	3	2	2	3	1	0	0	1	0	2	0	2	2	3
Avg	**3.00**	**2.33**	**1.67**	**2.00**	**3.00**	**1.00**	**0.00**	**0.00**	**1.00**	**0.00**	**2.00**	**0.00**	**1.67**	**1.67**	**3.00**

Detail Syllabus:

Unit	Content	Hrs
1	**Introduction to Industrial Automation and Control**: Architecture of Industrial Automation Systems. General review of process, Process control & automation, Servo and regulatory control, Characteristic parameter of a process: Process quality, Process potential, Process resistance, Process capacitance, Process lag, Self regulation.	8
2	**Different control modes and Implementation:** On-off control, Multistep, Time proportional, Proportional, Proportional-integral,Proportional-derivative, Proportional integral-derivative, integral windup, bump less transfer, Inverse derivative control, controller tuning techniques and selection guideline. Implementation of PID Controllers.	8
3	**Advance Industrial control strategies (Brief analysis):** Feedforward control, Cascade control, Ratio control, Selective Control, Split Range Control, Adaptive control.	6
4	**Actuators and final control elements:** Classification of Actuators: pneumatic, hydraulic electro-pneumatic, and stepper motor operated actuators. Pumps and motors, proportional and servo valves.	6
5	**Programmable Logic Controller:** Block diagram, Classification, Basic Architecture and Functions; Input-Output Modules, power supply. PLC Programming: Relay logic and ladder logic, PLC ladder diagram realization, PLC Timer, PLC Counter, advance instructions. PLC programming examples for Industrial maintenance and control.	6

6	**Distributed Control System (DCS):** Basic concept and overview of DCS, DCS System Architecture, configuration, operation and features. HMI and SCADA, OSI Communication Standard and Fieldbus.	6

Text books:

1. Industrial Instrumentation and Control, S. K. Singh, Tata-McGraw , 2010
2. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House, 2012.
3. Process Control, K. Krishnaswamy, New Age International Publishers, 2009
4. Programmable Logic Controllers with Control Logix, Jon Stenerson, Delmar Cengage learning, 2009

Reference books:

1. Automatic Process Control, D.P. Eckman, John Wiley and sons, 1958
2. Process control instrumentation technology, C.D. Johnson, PHI, 2005
3. Instrument Engineers Handbook, B.G. Liptak, CRC Press, 2003

Name of the course	**SENSORS AND TRANSDUCERS**
Course Code: OE-EE 801D	Semester: 8th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

Objective:

1.	To understand the principle of operation of Transducers and Sensors
2.	To understand the application of Transducers and Sensors

Pre-Requisite:

1.	Electric Circuit Theory (PC-EEE-301)
2.	Electromagnetic Field Theory (PC-EEE-303)

Course Outcomes:

CO1	Explain the basic principle of operation of Transducers and Sensors.
CO2	Distinguish different sensors and transducers.
CO3	Identify suitable transducer by comparing different industrial standards and procedures for measurement of physical parameters
CO4	Estimate the performance of different transducers.
CO5	Design real life electronics and instrumentation measurement systems.
CO6	Apply smart sensors, bio-sensors, PLC and Internet of Things to different applications

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	0	2	3	0	2	1	0	0	0	0	2	1	2	0
CO2	3	3	3	3	2	0	0	0	0	0	0	3	2	3	1
CO3	3	3	3	2	2	0	0	0	0	0	0	3	2	3	1
CO4	3	3	3	3	3	3	0	0	0	0	0	3	2	3	2
CO5	3	3	3	2	3	0	2	0	0	0	0	3	2	2	1
CO6	3	3	3	3	3	1	2	0	0	1	1	3	3	3	3
Avg	3.00	3.00	2.83	2.67	2.60	2.00	1.67	0.00	0.00	1.00	1.00	2.83	**2.00**	**2.67**	**1.60**

Detail Syllabus:

Unit	Conte	Hrs
1	**Introduction**: Definition, significance of measurement and instruments. Principle of sensing & transduction, transducer classification, Transducer characteristics, emerging fields of sensor technologies.	5
2	**Resistive transducers:** Potentiometers: types, loading error, metal and semiconductor strain gauges, types, resistance measuring methods, strain gauge applications: Load and torque measurement.	5
3	**Inductive transducers:** Transformer type, synchros, eddy current transducers, LVDT: Construction, material, input-output characteristics. **Optical Sensors:** LDR, Photo Diode, Stroboscope, IR Sensor.	7
4	**Capacitive transducers:**Variable distance-parallel plate type, variable area- parallel plate type, cylindrical type, differential type, variable dielectric constant type, calculation of sensitivity. Capacitive microphone, fluid level measurement. **Piezoelectric transducers:** piezoelectric effects, Materials, natural and synthetic types – their comparison, Charge and voltage co-efficient, Force and stress sensing, displacement measurement. **Magnetic Transducer:** Hall effect sensors, Magnetostrictive transducers: principle, positive and negative magnetostriction.	10
5	**Thermalsensors:** Resistance temperature detector (RTD): principle, materials and types; Thermistor: principle, materials and types; Thermocouple, Thermoelectric effects, laws of thermocouple, thermocouple types, construction. IC temperature sensor, PTAT type sensor. **Radiation sensors:** types, characteristics and comparison. Pyroelectric type.	4

6	**Micro-sensors and smart sensors:** Construction, characteristics and applications. Standards for smart sensor interface. **Recent Trends in Sensor Technologies:** Introduction; Film sensors (Thick film sensors, thin film sensor)	6

Text books:

1. Transducers and Instrumentation , D.V.S. Murthy, Prentice Hall, 2008
2. Sensors and Transducers, D. Patranabis, Prentice Hall India, 2003
3. Measurement Systems - Application and Design, E.O. Doebelin, McGraw-Hill, 2008

Reference books:

1. Instrument Transducers - An Introduction to their Performance and Design", H.K.P. Neubert , Oxford University Press, 1999.
2. Measurement Systems and Sensors, WaldemarNawrocki Artech House, 2016.
3. Semiconductor sensors", S.M. Sze, Wiley - Interscience, 1994
4. Instrumentation Measurement and Analysis", B. C. Nakara&Chaudhry TATA McGraw-Hill, 2009
5. Smart Sensors and Sensing Technology, Daniel E. Suarez, Nova Science Publishers, 2011

Name of the course	**Project Stage - II**
Course Code: PW-EE 881	Semester: 8th
Duration: 6 months	Maximum marks:100
Teaching Scheme	Examination scheme:
Theory: 0 hr/week	External Assessment: 100
Tutorial: 0 hr/week	
Practical: 16 hrs/week	
Credit Points: 8	

Course Outcomes:

CO1	Analyze the problem, formulation and solution of the selected project
CO2	Develop solutions for contemporary problems using modern tools for sustainable development.
CO3	Demonstrate ethical and professional sustainability while working in a team and communicate effectively for the benefit of the society.
CO4	Understand the engineering, finance and management principles.
CO5	Design engineering solutions to complex problems utilising a systems approach.
CO6	Communicate with engineers and the community at large in written an oral forms.

Mapping with CO – PO – PSO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1									0	0	2
CO2	3	2	3	2	3	2	2		3	3	2	3	0	1	3
CO3	2	3	2	3		1	1	3	2	1	1	3	3	0	3
CO4	3	1	3	2	1						1	2	2	1	2
CO5	1	3			3	1	2	2	1			1	3	1	3
CO6	2	3	2	1		1		1		3	2	1	3	3	2
Avg	**2.33**	**2.50**	**2.20**	**1.80**	**2.33**	**1.25**	**1.67**	**2.00**	**2.00**	**2.33**	**1.50**	**2.00**	**2.75**	**1.50**	**2.50**