Tripura University
(A Central University)

Curriculum
For
B. Tech. in Electrical & Computer Science Engineering
(ECSE)

(8th Semester)

2021

8th SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Program Elective-4	PE ECS 801/1	Smart Grid & IoT	3	0	0	3	3	100
		PE ECS 801/2	Introduction to Electrical Vehicle						
		PE ECS 801/3	Industrial Process Control						
2.	Program Elective-5	PE ECS 802/1	Biomedical Instrumentation	2	0	0	2	2	100
		PE ECS 802/2	Quantum Computing						
		PE ECS 802/3	Virtual Reality (VR)						
3.	Open Elective-3	OE ECS 803	Refer Annexure-III	3	0	0	3	3	100
4.	Open Elective-4	OE ECS 804	Refer Annexure-IV	2	0	0	2	2	100
5.	Project - 3	PR ECS 805	Project Work Final	0	0	12	12	6	200
6.	Seminar - 2	SE ECS 806	Seminar on Contemporary Engineering Topics - II	0	0	2	2	1	100
7.	Online Course	SW ECS 807	SWAYAM Courses	0	0	0	0	1	100
			Total :	10	0	14	24	**18**	**800**

Smart Grid & IoT

Course Code	PE ECS 801/1
Course Title	Smart Grid& IoT
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Introduction of Smart Grid, IoT.
Course Category	Program Elective (PE)
Number of classes	38 Hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Summarize the different type of communication implemented in Smart grid technology.	K2
CO-2	Able to distinguish of Distribution management System.	K2
CO-3	Illustratethe advanced metering infrastructure in the field of Smart grid.	K3
CO-4	Distinguishthe security concern of IoT based Smart Grid.	K4

Course Content:

Module 1: Smart GridCommunication (10 Hours)

Communication Technologies for Smart Grid, Interoperability and connectivity, Layered Architecture and Protocols, Standards for Information Exchange, Overview of existing communication technologies such as ZigBee, WLAN, cellular communication, WiMAX, Power Line Communication (PLC), their implementation in smart grids, advantages and disadvantages.

Module 2: Distribution Management System (08 Hours)

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Network Reconfiguration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Module 3: Advanced Metering infrastructure(10 Hours)

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing. Improved reliability of the power system using IoT.

Module 4:Security for IoT Based Smart Grid (10 Hours)

Cyber Security Context: Today's Grid, Tomorrow's Smart Grid, IoT-based Smart Grid's Security Issues and Challenges, Security Services for The IoT-Based Smart Grid, High level Security, privacy and the Smart Grid.Block chain technology, Block chain and IoT Enabled Smart Grids.

References / Suggested Learning Resources:

1. Smart grid handbook, Vol. 1 ,2,and 3 - By - Liu, Chen-Ching (Ed.) McArthur, Stephen(Ed.) Lee, Seung-Jae (Ed.) 2015.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Smart Grid: Fundamentals of Design and Analysis Book by James A. Momoh.
4. The Smart Grid: Enabling Energy Efficiency and Demand Response by Engr. Talha Arshad.
5. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, Smart Grid: Technology and Applications, Wiley, 2012.
6. Miadreza Shafie-khah (1st edition) Blockchain-Based Smart Grids.
7. NISTIR 7628 Rev. 1, Guidelines for Smart Grid Cybersecurity September 2014 The Smart Grid Interoperability Panel–Smart Grid Cybersecurity Committee**,** NISTIR 7628 (08/31/2010).

Introduction to Electric Vehicle

Course Code	PEECS 801/2
Course Title	Introduction to Electric Vehicles
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Electrical Machines, Drives, Power Electronics
Course Category	Program Elective (PE)
Number of classes	38 Hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources	K6
CO-2	Design and develop basic schemes of electric vehicles and hybrid electric vehicles.	K5
CO-3	Choose proper energy storage systems for vehicle applications	K6
CO-4	Identify various communication protocols and technologies used in vehicle networks	K2

Course Content:

Module 1: Introduction (10 Hours)

Basic concept of EV, Benefits of using EV, Classification of EV: HEV and PEV, Conventional HEV and grid able HEV, Concept of BEV, Challenges of EV's. Motor drive technology : IC engine based vehicles, force-speed characteristics of IC engine, Classification of EV motors, Concept of energy sources : batteries, ultra capacitors, ultra flywheels, Fuel cell, On board renewable energy sources : breaking energy, solar energy, waste heat energy, vibration energy.

Module 2: Battery charging technology **(10 Hours)**

Charging schemes for EV, battery swapping, concept of charging algorithms: Constant current charging (CC), Constant voltage charging (CV), Constant current constant voltage charging (CCCV), Multi stage charging (MSC), Pulse charging and Trickle charging (TC).
V2G system: Basic concept, V2G application in power system, Power converters for V2G operation.

Module 3: EV system configuration **(10 Hours)**

Multidisciplinary technologies required for EV system, EV configuration, Components of EV system, Typical BEV configuration, single motor and multi motor BEV configuration, Hybridization of energy sources and its importance, Drive train design for EV's, Series hybrid EV, Parallel hybrid EV, Series parallel hybrid EV, Complex hybrid EV, Starting, acceleration/deceleration, Normal driving, Regenerative breaking, Battery charging while driving, Battery charging at standstill.

Module 4: Energy Management Strategy **(08 Hours)**

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

References / Suggested Learning Resources:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRCPress, 2003.
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained,Wiley, 2003.
4. Ehsani, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles"CRC Press; Third edition (1 January 2019).
5. A.K Babu, Electric and hybrid vehicles, Khanna Book Publishing; 1st edition (1 January 2019).

Industrial Process Control

Course Code	PE ECS 801/3
Course Titles	Industrial Process Control
Number of Credits	3(L: 3, T: 0, P: 0)
Prerequisites	Analog Electronics, Industrial Instrumentation, Control of linear time in-variant Systems.
Course Category	Program Elective (PE)
Number of Classes	38 Hours

Course Outcome:

CO Number	CO Description	K-level

CO-1	Understand about the different Process Control Systems and their working principles.	K2
CO-2	Design of Process Controllers using different methods and implementations.	K4
CO-3	Understand about Feed-forward Control, Ratio Control, Multi-loop Control of Process and their implementations.	K3
CO-4	Understand about Final Control elements of Process Control and Supervisory control of large Industrial Plants.	K2

Course Content:

Module 1: Concepts of different Type of Processes (10 Hours)

Concept of Processes, Components of Process Control, Process dynamics of different type of Industrial processes, Process Control terminologies. Modeling of Standard first order and second order type processes with examples - flow control, level control, Temperature Control, Pressure control andHumidity Control, Capacitance type process, Resistance type process, Single time constant type process, Multiple time constant type process, Interactive and non-interactive type processes. Auto/Manual modes of operation. Bump-less transfer of Processes.

Module 2: Design and Implementation of Controllers for Process Control Systems (10Hours)

Controller Implementation : Implementations of Proportional and Integral Control, their Saturation, Characteristicsof P, PI, PD, and PID controllers for Process Control Systems, Provision foranti-integral windup and anti-derivative kick. Tuning of P, PI, PID Controllers using Process reaction Curve of Industrial Processes, Cohen-Coon method, Ziegler-Nichol's tuning method for implementation of PI, PD, and PID Controllers, Design of controllers with auto-tuning method employing relay feedback, Frequency domain design for Controllers. Flow Loop control design Using Caldwell's and Sundaresan's Methods.

Module 3: Advanced Process Control employing Ratio, feed-forward and Multi-loop (08 Hours)

Structure & Implementations of Feed-forward control, Ratio Control, Multi-loop and Cascade control with examples-their Transfer functions, advantages & disadvantages and their modifications. Interaction and decoupling, Non-linear effects in plants and controllers. Boiler Drum Level Control-different techniques.

Module 4: Final Control elements and sequential & Supervisory Control (10 Hours)

Final control elements in process control loop. Type of Actuators: Pneumatic, Electrical, Hydraulic. Positioners. Pneumatic to electrical Signal and. electrical to pneumatic signal converters. Control valves: Classifications & Characteristics of Control Valves, single stem and double stem sliding valves, Valve sizing technique. Concepts of Modulating and Sequential Control. Structure of Modulating Control loops. Supervisory control: Objectives and Implementation in Process Control.

References / Suggested Learning Resources:

1. Smith & Corripio, Principles and Practice of Automatic Process Control.
2. Eckman, Automatic Process Control.
3. Shinskey, Process Control Systems.
4. Process Systems Analysis and Control - Coughanowr & Koppel

5. Anand, M.M.S., Electronic Instruments & Instrumentation techniques, PHI, 2004
6. D. Patranabish, Industrial Instrumentation, PHI
7. Krishna Kanth, Computer based Industrial Control, PHI, 2005
8.SeborG-Edgar-Doyle, Process Dynamics and Control, John wiley, 2011
9. C. D. Johnson, Process Control Instrumentation Technology, PHI, 2004
10. Surekha Bhanot, Process Control Principal and Applications, PHI, 2008.
11.Stephanopoulous, Chemical Process Control, PHI, 1984

Bio-Medical Instrumentation

Course Code	PEECS 802/1
Course Title	Bio-Medical Instrumentation.
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Electrical Measurement & Instrumentation
Course Category	Program Elective (PE)
Number of classes	26 Hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Relate the basic fundamental concept instrumentation that are used in bio-medical field.	K2
CO-2	Demonstrate how to monitor the condition of patients using different electrical application based instruments.	K3
CO-3	Compare the different modern Imaging System used in biomedical applications	K4
CO-4	Understand the working of different therapeutic Equipment used in biomedical applications	K1

Course Content:

Module 1: Introduction to Bio-Medical instrumentation (08 Hours)

Basic components of bio-medical system, Role of bio-medical transducers, classifications of transducers, concept of pressure transducer, temperature transducer, photo electric transducers. Optical fibre sensors and smart sensors. Classification and applications of electrodes, Importance of signal conditioning circuits, concept of instrumentation amplifier, isolation amplifier, chopper amplifier and carrier amplifier, Patient safety: Electric shock hazards, safety codes for electromedicalequipments, testing of bio-medical equipment's.

Module 2: Patient monitoring instruments (06 Hours)

Concept of ECG, EEG, EMG, ERG. Measurement of heart rate and blood flow, concept of pulse oximeters, Bio telemetry system and its importance, Concept of spirometry, Holter monitor and cardiac stress test, Blood gas analyzer.Measurement of blood pressure.

Module 3: Modern Imaging System(06 Hours)
Different types of analytical and diagnostic instruments.Working concept of X-Ray machine, computed tomography (CT), magnetic resonance imaging system (MRI), Ultrasonography. Doppler ultrasonography and contrast ultrasonography.Pulmonary function measurements.Plethysmography: Photo plethysmography and Body plethysmography.

Module 4: Therapeutic Equipment (06 Hours)

Cardiac pacemaker with classification, Concept of cardiac defibrillators – its importance and types, principle of surgical diathermy, safety aspects in electro surgical units, applications of laser in bio-medical field, concept and working of haemodialyzer machine, concept of ventillators, its classifications, Concept of Heart-Lung machine.

References / Suggested Learning Resources:

1. Handbook of Biomedical Instrumentation, by: R.S Khandpur (Tata McGraw Hill, 3e).
2. Biomedical Instrumentation and Measurements, by : Leslie Cromwell, Fred J. weibell, Erich A. Pfeiffer (PHI publications).
3. Essentials of Biomedical instruments and Techniques by : C.S Datta (AITBS publishers).
4. Biomedical Instrumentation and Measurements, by : R. AnandaNatarajan (PHI publications).
5. Text book of Biomedical Instrumentation, by : K.N Scott, A.K Mathur (CBS publishers).

Quantum Computing

Course Code	PE ECS 802/2
Course Title	Quantum Computing
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Data Structure and Algorithm, Programming in Python/C#
Course Category	Program Elective (PE)
Number of classes	26 Hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Explain the working of a Quantum Computing program, its architecture and programmodel.	K2
CO-2	Develop quantum logic gate circuits.	K3
CO-3	Develop quantum algorithm.	K3
CO-4	Program quantum algorithm on major toolkits.	K5

Course Content:

Module 1: Introduction to Quantum Computing (06 Hours)

Motivation for studying Quantum Computing, major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), origin of Quantum Computing.
Overview of major concepts in Quantum Computing: Qubits and multi-qubits states, Bra-ket notation, Bloch Sphere representation, Quantum Superposition, Quantum Entanglement.

Module 2: Math Foundation for Quantum Computing (06 Hours)

Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.

Module 3: Building Blocks for Quantum Program (06 Hours)

Architecture of a Quantum Computing platform.Details of q-bit system of information representation: Block Sphere, Multi-qubits States, Quantum superposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perceptive e.g. Bell State, Operation on qubits: Measuring and transforming using gates, Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc.
Programming model for a Quantum Computing Program: Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits.

Module 4: Quantum Algorithms (08 Hours)

Basic techniques exploited by quantum algorithms: Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks
Major Algorithms: Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch -Jozsa Algorithm
OSS Toolkits for implementing Quantum program: IBM quantum experience, Microsoft Q, Rigetti PyQuil (QPU/QVM).

References / Suggested Learning Resources:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley.
3. IBM Experience: https://quantumexperience,ng,bluemix.net
4. Microsoft Quantum Development Kit https://www.microsoft.com/en-us/quantum/development-kit
5. Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/

Virtual Reality

Course Code	PE ECS 802/3
Course Title	Virtual Reality
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Fundamentals of C++
Course Category	Program Elective (PE)
Number of classes	26 Hours

Course Outcome:

After completing the course in Virtual Reality, the students will be able to:

CO Number	CO Description	K-level
CO-1	Understand geometric modelling and Virtual environment.	K2
CO-2	Analyze Virtual Hardware and Software.	K3
CO-3	Develop Virtual Reality applications.	K5
CO-4	Design and animating the virtual Environment.	K3

Course Content:

Module 1: Introduction to Virtual Reality (04Hours)

Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.
3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism-Stereographic image.

Module 2: Geometric Modeling (06 Hours)

Geometric Modeling: Introduction, From 2D to 3D, 3D space curves, 3D boundary representation.
Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection.
Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

Module 3: Virtual Environment (08Hours)

Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object inbetweening, free from deformation, particle system.
Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

Module 4: VR Hardware and Software (08 Hours)

Human factors: Introduction, the eye, the ear, the somatic senses.
VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems.
VR Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML
VR Applications: Introduction, Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

References / Suggested Learning Resources:

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
2. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.
3. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.
4. Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology”, Wiley Inter Science, 2nd Edition, 2006.
5. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application and Design”, Morgan Kaufmann, 2008.
6. www.vresources.org
7. www.vrac.iastate.edu
8. www.w3.org/MarkUp/VRM

Project Work Final

Course Code	PR ECS 805
Course Title	Project Work Final
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Project (PR)
Number of classes	130 Hours

Course Outcome :-

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K2
CO-2	Develop the skill of working in a Team	K3
CO-3	Design engineering solutions to complex problems utilizing a systematic approach	K6
CO-4	Design the solution of an engineering project involving latest tools and techniques	K6
CO-5	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K3
CO-6	Demonstrate the knowledge, skills and attitudes of a professional engineer	K2

Course Content:-

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.
6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Develop knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10) Demonstrate the implementation of a project work.

Seminar on Contemporary Engineering Topics – II

Course Code	SE ECS 806
Course Title	Seminar on Contemporary Engineering Topics – II
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Seminar (SE)
Number of classes	24 Hours

Course Outcome:-

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K3
CO-2	Survey literature to understand insight of the selected topic	K4
CO-3	Develop report writing and presentation making skill	K3
CO-4	Present the topic so prepared among audience using suitable aid	K3

Course Content:-

Each student shall:

1) Identify a topic of current relevance in his/her branch of engineering,
2) Get approval of the faculty concerned/HOD,
3) Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4) Prepare their own report and presentation slides and
5) Present in the class among fellow students and faculty members.

SWAYAM Courses

Course Code	SW ECS 807
Course Title	SWAYAM Courses
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Online Course (SW)
Number of classes	-

Courses Outcome:-

CO Number	CO Description	K-level
CO-1	Make use of digital learning platform to enhance knowledge and skill beyond the prescribed curriculum structure	K3
CO-2	Take part in proctored examination system to prepare oneself for similar future challenges	K4
CO-3	Utilize the opportunity to learn from best faculty in the countryfor professional development	K3
CO-4	Develop the skill of lifelong self-learning and become future ready	K3

Courses Content:-

SWAYAM (Study Webs of Active-learning for Young Aspiring Minds); India Chapter of Massive Open Online Courses. SWAYAM is an indigenous developed IT platform, initiated by Government of India, which is instrumental for self-actualization providing opportunities for a life-long learning. Learner can choose from hundreds of courses, virtually every course that is taught at the university/college/school level and these shall be offered by best of the teachers in India and elsewhere. Student having registered a course, having submitting the Assignments as per requirements of the course, shall at the end of each course, be assessed through a proctored examination. A student having successfully completed the course shall get a Certificate.

Each student has to undergo and qualify at least two relevant SWAYAM or equivalent courses (to be certified by concerned HOD) with certification during the entire course of B. Tech. program. The Head of the departments will approve the relevancy of a SWAYAM or equivalent course for respective branch of engineering.

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