SEMESTER S8

BIO MECHATRONICS

Course Code	PEMRT861	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce students to basic biomedical engineering technology and different biological signals, their acquisition, measurements and related constraints.
2. Understand principles, techniques, procedures, and equipment used in bio-medical instrumentation.

KTU SPECIAL

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Bio potential and bio electrodes:** Cell structure – electrode – electrode potential- resting and action potential –Refractory period- Electrode electrolyte interface, Half-cell potential, Polarisable and Non-polarisable electrodes - Skin electrode interface – Bioelectrodes: Types of electrodes- Micro electrodes, Depth and Needle electrodes, Surface electrodes- Equivalent circuits of electrodes	9
2	**Biopotential Recorders:** Characteristics of the recording system, Electrocardiogram - Einthoven triangle, Standard 12-lead configurations - ECG Machine-Electroencephalograp hy(EEG) –Brain waves, waveforms & measurements, Evoked potentials,Sleep stages , 10-20 electrodes placement system for EEG – EEG machine	9

3	**Measurement of Physiological Parameters:** Blood Pressure measurement- Blood Flow Meters: Need for blood flow meters, **E**lectromagnetic blood flowmeters- Applications of electromagnetic blood flowmeters, Ultrasonic blood flowmeter: Ultrasonic blood flowmeter based on transit time principle, Doppler blood flowmeters-laser based Doppler blood flowmeters-Cardiac output measurements.	**9**
4	**Physiological Assist Devices:** Pacemakers, Defibrillators, Nerve and muscle stimulators, Heart lung machine- ventilators-Basic ideas of CT scanner- MRI scanner and ultrasonic scanner-Devices to protect against electrical hazards- Microshock and macroshock, Centralized patient monitoring system.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

KTU SPECIAL

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

KTU SPECIAL

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the bio potential and bio electrodes	**K2**
CO2	Understand the Characteristics of the recording system	**K2**
CO3	Understand the measurement of Physiological Parameters	**K2**
CO4	Understand the Physiological Assist Devices	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									2
CO2	3	3	2									2
CO3	3	3	2									2
CO4	3	3	2									2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Textbook of Medical Physiology	Arthur C.Guyton	PrismBooks(Pvt)Ltd &W.B.Saunders Company	12th edition,2012
2	Bio Medical Instrumentation	Dr.Arumugam M	Anuradha agencies Publications	2nd edition,2002
3	Handbook of Medical Instrumentation	Khandpur R S	Tata McGraw Hill, New Delhi.	2004

KTU SPECIAL

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronics in Medicine and Biomedical Instrumentation	Nandini K	jog PHI	Second Edition 2013
2	Instrument transducer – An introduction to their performance and design	Hermann K P Neubert	Clarendon Press	1975
3	Biomedical sensors – Fundamentals and application	Harry N Norton	Noyes Publications	1982
4	Principles of applied biomedical instrumentation	L.A Geddes , L.E. Baker	Wiley india Pvt. Ltd	third addition, 2008

KTU SPECIAL

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_bt33/preview
2	https://onlinecourses.nptel.ac.in/noc22_ee87/preview
3	https://onlinecourses.swayam2.ac.in/nou23_bt05/preview
4	https://nptel.ac.in/courses/102106094

SEMESTER S8

HYBRID & ELECTRIC VEHICLES

Course Code	PE44T862	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Introduces the fundamental concepts of electric, hybrid and autonomous vehicles, drive trains, electrical machines used, energy storage devices, charging systems and different communication protocols.

KTU SPECIAL

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Hybrid Electric Vehicles:** History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. **Conventional Vehicles:** Basics of vehicle performance, vehicle power source characterization, transmission characteristics. **Hybrid Electric Drive-trains**: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies. **Electric Drive-trains:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies.	9
2	**Electric Propulsion unit**: Introduction to electric components used in hybrid and electric vehicles. **DC Drives:** Review of Separately excited DC Motor control – Speed and torque equations - Independent control of orthogonal flux and torque -	9

	Closed loop control of speed and torque (block diagram only). **PMSM Drives:** PMSM motor basics – Independent control of orthogonal flux and torque (concept only)- Field Oriented Control (FOC) – Sensored and sensorless control (block diagram only).	
3	**Energy Storage:** Introduction to energy storage requirements in Hybrid and Electric Vehicles- Battery based energy storage systems,Battery Management System, Types of battery- Fuel Cell based energy storage systems- Supercapacitors-Hybridization of different energy storage devices. **Overview of Electric Vehicle Battery Chargers** - On-board chargers, Electric Vehicle Supply Equipment (EVSE) - Grid to EVSE to On-board chargers to battery pack power flow block schematic diagrams – Types of charging stations - AC Level 1 & 2, DC - Level 3 – V2G concept-Types of Connectors - CHAdeMO, CCS Type1 and 2, GB/T - PIN diagrams and differences.	**9**
4	**Sizing the drive system:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics. **Vehicle Communication protocols :** Need & requirements - Functions of Control Pilot (CP) and Proximity Pilot (PP) pins, Communication Protocols - CAN, LIN, FLEXRAY (Basics only)- Power line communication (PLC) in EV.	**9**

KTUSPECIAL

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts of Conventional, Electric, Hybrid EV and describe different configurations of electric and hybrid electric drive trains	**K2**
CO2	Discuss the propulsion unit for electric and hybrid vehicles	**K2**
CO3	Compare various energy storage and EV charging systems	**K2**
CO4	Select drive systems and various communication protocols for EV	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1					2					2
CO2	3	2										2
CO3	3	2										2
CO4	3	3	2									2
CO5	3	1	2									2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

KTU SPECIAL

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hybrid Electric Vehicles – Principles and applications with practical perspectives	Chris Mi, M A Masrur, D W Gao	Wiley	2011
2	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Hussein	CRC Press	2003

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electric Vehicle Technology Explained	James Larminie, John Lowry	Wiley	2003
2	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design,	Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi	CRC Press	2004

KTU SPECIAL

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108/103/108103009/
2	https://nptel.ac.in/courses/108/102/108102121/
3	https://nptel.ac.in/courses/108/106/108106170/
4	https://nptel.ac.in/courses/108/103/108103009/