West Bengal State Council of Technical & Vocational Education and Skill Development
(Technical Education Division)

Syllabus
of

Diploma in Electronics & Tele-Communication Engineering [ETCE] & Electronics & Communication Engineering [ECE]

Part-III (5th Semester)

Revised 2022

Further suggestion may be submitted to the syllabus committee. List of the coordinators for the branch of Diploma in Electronics & Tele Communication Engineering are:

Sl No.	Name	Designation	Mobile No.	Email id
1.	Sri Ashim Kumar Manna	OSD to the DTE&T (On Deputation) (Lecturer in ETCE)	8902701784	ashimmanna1962@gmail.com
2.	Dr. Marina Dan	Lecturer in ETCE	9831115387	marina@wbscte.ac.in
3.	Dr. Anup Sarkar	Lecturer in ETCE	9433521132	anup@wbscte.ac.in
3.	Sri Rabindra Nath Kundu	Lecturer in ETCE	9064483649	rabink@wbscte.ac.in
5.	Sri Sanku Prasad Mitra	Lecturer in ETCE	9830548556	sanku@wbscte.ac.in
6.	Sri Sumit Kumar Das	Lecturer in ETCE	9830551752	sumit.rick@wbscte.ac.in
7.	Ms. Kakali Mudi	Lecturer in ETCE	9051931699	kakali.electronics@wbscte.ac.in

WEST BENGAL STATE COUNCIL OF TECHNICAL EDUCATION											
TEACHING AND EXAMINATION SCHEME FOR DIPLOMA IN ENGINEERING COURSES											
COURSE NAME: FULL TIME DIPLOMA IN ELECTRONICS & TELECOMMUNICATION ENGINEERING											
DURATION OF COURSE: 6 SEMESTERS											
SEMESTER: FIFTH											
BRANCH: ELECTRONICS & TELECOMMUNICATION ENGINEERING											
SR. NO.	SUBJECT	CREDITS	PERIODS		EVALUATION SCHEME						
			L	PR	THEORETICAL				PRACTICAL		Total Marks
					TA	CT	Total	ESE	Internal	External	
1.	Embedded Systems	3	3	-	20	20	40	60	-	-	100
2.	Advanced Communication System	3	3	-	20	20	40	60	-	-	100
3.	Industrial Electronics Or Medical Electronics	3	3	-	20	20	40	60	-	-	100
4.	Internet of Things Or Mobile Communication	3	3	-	20	20	40	60	-	-	100
5.	Essence of Indian Knowledge, Tradition and Indian Constitution	1	2	-	20	20	40	60	-	-	100
6.	Embedded Systems Lab	1	-	2	-	-	-	-	60	40	100
7.	Advanced Communication System Lab	1	-	2	-	-	-	-	60	40	100
8.	Industrial Electronics Lab Or Medical Electronics Lab	1	-	2	-	-	-	-	60	40	100
9.	Hands on Internet of Things Or Mobile Communication	1	-	2	-	-	-	-	60	40	100
10.	Project	2	-	4	-	-	-	-	60	40	100
11.	Internship-II	1	-	-	-	-	-	-	-	-	100
	Total	20	14	12	100	100	200	300	300	200	1100

- STUDENT CONTACT HOURS PER WEEK: 26+2 = 28 hours (2 hours for Library)
- ACADEMIC CONTACT WEEKS PER SEMESTER : 17 weeks (Teaching-15 weeks + Internal Exam-2 weeks)
- THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH
- ABBREVIATIONS: L- Lecture, PR- Practical, IA- Internal Assessment, CT- Class Test, ESE- End Semester Exam
- IA (Internal Assessment for Theoretical) = 40 marks: CT= 20 Marks, Attendance =10 marks and Quizzes/Assignment/Student Activity = 10 marks.
- Minimum qualifying marks for both Theoretical and Sessional subjects (for internal assessment and external assessment separately) are 40%.
- IA (Internal Assessment for Practical) =60 marks: 50 marks for continuous evaluation and 10 marks for Class attendance.
- Internship-II will be completely assessed internally.

Name of the course: Embedded Systems	
Course Code: ETCE/DEMS/S5	Semester: Fifth
Duration: One Semester (Teaching-15 Weeks + Internal Exam-2weeks)	Maximum Marks:100 Marks
Teaching Scheme:	**Examination Scheme:**
Theory: 3contact hrs./week	Class Test(Internal Examination):20 Marks
Practical:2contact hours/week	Attendance=10 marks and Quizzes/Assignment/Student Activity= 10 marks
	End Semester Examination:60 Marks
Credit:4(TH:3+PR:1)	Practical:100 Marks

Course Outcomes:

- Students will acquire knowledge on the function and area of application of Arduino and PIC 18 Microcontroller based embedded systems used in modern electronics control and Artificial Intelligence Systems.
- Students will have a clear idea of basic function, characteristic and application of Embedded C Software in the modern embedded systems.
- Students will be able to build small Arduino & PIC 18 Microcontroller based project based on real life applications.

	Content(Name of the topic)	Periods
	Group–A	
Unit 1	**Embedded System Design Basics**	**03**
	1.1 Introduction to embedded systems. 1.2 Components of embedded system. 1.3 Comparison among 8051, Arduino and PIC	
Unit 2	**Architecture review of Arduino Uno board**	**10**
	2.1 Introduction to ARDUINO, ARDUINO History and Family- Mega, Nano, Bluetooth, Lilypad. 2.2 Pin configuration and architecture Of ATmega328 microcontroller 2.3 Study of an Arduino Board- Power Supply, Power Connectors, Analog Inputs, Digital Connections, crystal oscillator, Reset switch, Serial Programming Connector etc. 2.4 Concept of digital and analog ports. 2.5 General Hardware Interfacings: • LED's • Switches • Seven Segment Display • Multi Segment Displays • Relays (AC Appliance Control) • LCD • Buzzer	
	Group–B	
Unit 3	**Embedded C programming simulation model for Arduino**	**10**
	3.1 Introduction to Embedded C and steps to install Arduino Integrated development platform. 3.2 Basic commands for Arduino Functions, Parameters, Variables- Global, local and static, Numeric variables-Int, Float, Boolean, # Define directives, Looping statements-if, for, while, Logical Operators, Mathematical operators, Return values, Coding styles – Indentation, opening Braces, Whitespace, Comments, Arrays and strings, Morse code translator, Pinmode- to configure the Digital and Analog pins as Input or Output pin, Standard Arduino library- Random number, Math function, bit manipulation, Advanced I/O, Interrupts, storing a Integer, Float and string data types in EEPROM, Clearing the	

	contents of EEPROM, Range compression, Arduino Ethernet programming, Programming with Arduino IDE, Compiling and Debugging using IDE 3.3 Proteus simulation model for Arduino	
Unit 4	**PIC 18 Architecture and its programming**	**10**
	4.1 PIC 18 architecture and assembly level programming a) The WREG register in PIC b) PIC file register c) Using instruction with the default access bank d) Status register e) PIC data format and directives f) Branch, call and time delay loop 4.2 Proteus simulation model for PIC 4.3 PIC I/O port programming 4.4 ADC programming	
	Group–C	
Unit 5	**I/O interfacing , Programming and Simulation model**	**12**
	5.1 LED interfacing with Arduino /PIC - Circuit diagram, program for LED blinking, Proteus simulation model 5.2 2Single switch and seven segment interface with Arduino /PIC - Circuit diagram, program for increment digit, Proteus simulation model 5.3 Sensors (Temperature, Light, Proximity) and LED/LCD interface with Arduino /PIC- Circuit diagram, program, Proteus simulation model 5.4 Interfacing with DC motor with Arduino /PIC –speed control program with direction change: Circuit diagram, program, Proteus simulation model 5.5 Interfacing with Stepper motor with Arduino /PIC –speed control program with direction change: Circuit diagram, program, Proteus simulation model	
	Total	**45**

Sl.No.	**Suggested List of Laboratory Experiments**
1	Installation of Arduino software from the website www.arduino.cc.
2	Installation software From MPLAB IDE and MPLAB XC from microchip website.
3	Installation of Proteus software for simulation purpose.
4	Built-in LED state control by push button sketch implementation (Arduino /PIC)
5	Built-in LED blinking sketch implementation (Arduino /PIC)
6	Built-in LED blinking by toggling states based on binary operation (Arduino /PIC)
7	Controlling multiple LEDs with a loop and an array (Arduino /PIC)
8	Use a potentiometer to control the blinking of an LED (Arduino /PIC)
9	Temperature monitor using LCD display and LM35 (using Adrino /PIC)
10	Light sensor interfacing and sending its reading using I2C Communication Protocol (using Arduino /PIC)
11	Servo Motor Control using PWM(Arduino /PIC)
12	Mini projects on 1. Home automation. (Arduino /PIC) 2. Solar Street Light system. (Arduino /PIC) 3. Clock. (Arduino /PIC)

	4. Solar charge controller(Arduino /PIC) 5. RTC clock(Arduino /PIC)

Software(s) required: 1. Arduino Integrated Development Environment Software. 2. Free software MPLAB IDE and MPLAB XC are available in microchip website. 3. Proteus software can be used for simulation purpose.

Hardware(s) required: 1. ARDUINO UNO R3 Board with USB Cable
• Microcontroller ATmega328 • Operating Voltage: 5V • Input Voltage (Recommended): 7-12V • Digital I /O Pins- 14 (of which 6 provide PWM output) •Analog I/O pins-6, Flash memory 32 KB (ATmega328) of which 0.5 KB used by bootloader ,SRAM 2 KB (ATmega328) , EEPROM –1KB , Clock Speed 16 MHz , Both 5V and 3.3 V power rails, Proper Indicator LED's, Power jack and USB connection., Breadboard Compatibility (dimension of a 40 pin DIP IC).
2. PIC kit 3.5+ In-Circuit Debugger/Programmer compatible to Microchip uses in-circuit debugging logic incorporated into each chip with Flash memory to provide a low-cost hardware debugger and programmer. The PIC kit 3.5+ allows debugging and programming of PIC and dsPIC Flash microcontrollers using the powerful graphical user interface of the MPLAB Integrated Development Environment (IDE).

References:

Sl No.	Title of Book	Author	Publication
1.	Arduino-Based Embedded Systems	Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury	Taylor& Francis
2.	Embedded C	Pont, Michael J	Addison- Wissley professional
3.	Getting Started with Arduino: The Open Source electronic prototyping platform	Massimo Banzi	Shroff Publishers & Distributors Pvt Ltd, 2014
4.	Programming Arduino: Getting Started with Sketches	Simon Monk	McGraw-Hill Education, Second Edition,2016
5.	Arduino Cookbook	Margolis	Shroff/O'Reilly Publication, 2nd edition 2012
6.	Embedded Systems	Himanshu Dave, Parag Dave	Pearson (ISBN: 9789332543522)
7.	Arduino Made Simple	Ashwin Pajankar	
8.	PIC Microcontroller and Embedded systems using Assembly and C for PIC18	M.A.Mazidi, R.D. Mckinlay and D. Causey	Pearson
9.	The Essential PIC 18 Microcontroller	Sid Katzen	Springer
10.	Fundamentals of Microcontrollers and Applications in Embedded system (with the PIC 18 microcontroller family)	R. Gaonkar	Penram International Publishing

Resources:

1. https ://www.arduino.cc/en/Tutorial/HomePage
2. www.microchip.com
3. www.pictutorials.com

Name of the course: Advance Communication System	
Course Code: ETCE/DACS/S5	Semester: Fifth
Duration: One Semester(Teaching-15 Weeks + Internal Exam-2weeks)	Maximum Marks:100 Marks
Teaching Scheme:	**Examination Scheme**
Theory: 3contact hrs./week	Class Test(Internal Examination):20 Marks
Practical:2contact hours/week	Attendance=10 marks and Quizzes/Assignment/Student Activity= 10 marks
	End Semester Examination:60 Marks
Credit:4(TH:3+PR:1)	Practical:100 Marks

Course Outcomes:

- Students will acquire knowledge on the purpose, requirement and function and area of application of wireless telecommunication at different frequency band used in modern communication system.
- Students will have a clear idea of basic function, characteristic and application of different types of Antenna used in wireless telecommunication system.
- Students will able to know how to work in the field of optical communication system.

Content(Name of the topic)		Periods
	Group–A	
Unit 1	**Satellite Communication**	**07**
	1.1 Kepler's Law – Orbital period and Satellite speed – Types of orbits – polar – inclined – equatorial – LEO – MEO – GEO – Station keeping – Satellite Launching process – Attitude control 1.2 Transponder- Frequency allocation – Frequency reuse 1.3 Function of Communication Satellite with block diagram 1.4 Principles of FDMA and TDMA and their use in Satellite communication.	
Unit 2	**RADAR Systems**	**06**
	2.1 Principle operation of RADAR – PPI – Duplexer – RADAR range – Frequency and Power range of RADAR 2.2 Function of Pulsed RADAR – Function of MTI – Doppler effect – Blind speed	
	Group–B	
Unit 3	**Mobile Communication and modern wireless communication system**	**12**
	3.1 Overview of cellular system – 2G, 3G, 4G and 5G concept – Frequency reuse – location update and call setup – Hand off and power control 3.2 Block diagram and operation of mobile (hand set) unit – Frequency synthesizer – Transmitter unit – Receiver unit – Logic unit – Control unit 3.3 Mobile Base Station – Mobile Control Station 3.4 Digital cellular system – GSM architecture – protocol – security aspect 3.5 Modern wireless Network – Universal mobile telecommunication service (UMTS) –	

	LTE – CDMA – SCDMA – Wireless local loop (WLL) – Local multipoint distribution service (LMDS) technology 3.6 Concepts of Blue-tooth, Wi-Fi and Wi-max	
Unit 4	**Antenna**	**08**
	4.1 Basic principle of Antenna – Characteristic and features of different Antenna – Dipole – Half wave dipole – folded dipole – horn antenna – dish antenna – parabolic antenna – array antenna – Yagi-Uda antenna – their application and use. 4.2 Properties of antenna – Gain – Bandwidth – beam width – impedance – radiation pattern of different antenna (Dipole, half and full wave dipole, half and full wave folded dipole)	
	Group–C	
Unit 5	**Optical communication system**	**12**
	5.1 Basic principle of fiber optic communication system – advantage and limitations of optical fiber communication - Construction of optical fiber – types of fibers – mono mode – multimode – step index and graded index 5.2 Optical fiber performances – bandwidth distance product – Transmission Losses 5.3 Optical Sources – LED – LASER – Modulation of LED and LASER – Function and principle operation of optical detectors – Photo diode – PIN – photo transistor – APD 5.4 Components of optical fiber – coupler – connector – splices 5.5 Block diagram of optical fiber communication system and its operation – basic idea of fiber optic networking 5.6 Fiber distributed Data Interface (FDDI) – Synchronous optical network (SONET) 5.7 Multiplexing of optical signals – WDM – OFDM. 5.8 Application of SS Modulation	
	Total	**45**

Sl. No.	**Suggested List of Laboratory Experiments**
1	To study the function of fiber optic analog link
2	To study the frequency response of optical receiver at various load conditions
3	To study the propagation loss in optical fiber
4	To study the bending loss in optical fiber.
5	To study the numerical aperture of optical fiber
6	To study the radiation pattern and to obtain the polar plot of half wave dipole antenna, full wave dipole antenna, folded dipole antenna and Yagi-Uda antenna.
7	To set up a satellite communication link and study of change in uplink and downlink frequency
8	To establish an Audio-Video satellite link between transmitter and receiver
9	To find the maximum range of RADAR (using simulation software)
10	To study the behavior of the CDMA Direct sequence Spread spectrum modulation and demodulation.
11	To study and analyze the Mobile Phone.

12	Mini projects on (A) To design an optical fiber link (B) To develop any control system using optical source and detectors (C) To develop a voice communication link using optical fiber (D) FM transmitter

References:

Sl No.	Title of Book	Author	Publication
1.	Principles of communication systems	Taub Schilling	T.M.H
2.	Communication Systems	Simon Haykin	Wiley
3.	Modern Digital & Analog Communication	B.P. Lathi	Oxford Publications
4.	Communication Systems (Analog and Digital)	Dr. Sanjay Sharma	S. K. Kataria& Sons
5.	Advanced Electronic Communication System	Wayne Tomasi	P. H. I.
6.	Electronic Communication Systems	Kennedy, Devis	T.M.H.
7.	Electronics Communication	Frenzel	T.M.H.
8.	Wireless Communications – Principles and Practice	T. S. Rappaport	Pearson
9.	Modern Wireless Communications	Haykin And Mother	Pearson

Name of the course: Internet of Things	
Course Code: ETCE/DIoT/S5	Semester: Fifth
Duration: One Semester(Teaching-15 Weeks + Internal Exam-2 weeks)	Maximum Marks:100 Marks
Teaching Scheme:	**Examination Scheme**
Theory:3contact hours/ week	Class Test(Internal Examination):20 Marks
Practical:3contact hours/week	Attendance=10 marks and Quizzes/Assignment/Student Activity=10 marks
	End Semester Examination: 60 Marks
Credit:4(TH:3+PR:1)	Practical:100 Marks
Course Outcomes:	
On completion of the course students will be able to: • Understand the concept of Internet of Things • Explore on use of various hardware and sensing technologies to build IoT applications • Illustrate the architecture of Internet of Things and python • Understand the working with python on Arduino and Raspberry Pi	

Content(Name of the topic)		**Periods**
Group – A		
Unit 1	**Introduction to Internet of Things**	**07**

	1.1 Introduction to Internet of Things, Define the term “Internet of Things”. 1.2 Essential blocks of an IoT system, along with explanation. 1.3 Detail architecture of an IoT system. 1.4 Necessity of embedded system into the IoT	
Unit 2	**Sensors, Actuators and Networking involved in IoT**	**11**
	2.1 Need of Sensors and actuators involved in IoT systems. 2.2 Basic aspects of the networking involved in Internet of Things (MQTT, CoAP), Basic idea on Communication Protocols (like Zigbee, Bluetooth etc.) and Sensor networks (like WSNs).	
	Group – B	
Unit 3	**Basics of Python programming**	**10**
	3.1 Importance of Python based programming in IoT development platforms compare to others programming languages, Basics of Python programming, Idea on Python IDE (Spyder). 3.2 Printing statement with indentation, data-types (Numbers, String, List, Tuple, Dictionary), Controlling statements (if-elif-else, while, for, break, continue) 3.3 Definition of function (without return value, with return value), Calling of function with examples, Functions as Objects (with examples), Variables (Global, Local) with examples, Modules with examples, Exception Handlers with examples 3.4 File read/write operations (Open, Read/Write, Close) with examples, Image read/write operations, network services for client server model	
Unit 4	**IoT development with different platforms (Arduino, Raspberry Pi)**	**11**
	4.1 Study of Arduino board and its interfacing (using Python programming) 4.2 Importance of Raspberry Pi in the development of IoT (compare to Arduino). Basic Architecture, Pin details, Installation and configuration, Applications of Raspberry Pi. 4.3 Implementation of IoT with Raspberry Pi (Read data from sensor and sending data to a server)	
	Group – C	
Unit 5	**IoT applications in Agriculture, Healthcare and Activity Monitoring**	**06**
	5.1 Smart Water Management System using IoT: Architecture and design 5.2 Remote Healthcare System, Real-time monitoring and Preventive care system : Architecture and design 5.3 Smartphone based activity monitoring system : Architecture and design	
	Total	**45**

Sl. No.	**Suggested List of Laboratory Experiments**
1	Establish an MQTT connection in order to communicate with the server over the MQTT protocol.
2	Publish and subscribe data by MQTT Client
3	Installation of Python IDE (Spyder), use of editor and console separately, Python distribution using anaconda.
4	Implementation of printing and controlling statements.
5	Implementation of data-types, variables, functions, modules.

6	Python programming with Arduino
7	Installing Raspbian OS, Familiarizing with Raspberry Pi Components and interface, Connecting to Ethernet, Monitor, USB
8	Displaying different LED patterns with Raspberry Pi
9	Interface sensor and Actuator with Raspberry Pi
10	IoT based Web Controlled Home Automation using Raspberry Pi
11	Mini Project

References:

Sl No.	Title of Book	Author	Publication
1.	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill Education; First edition (10 March 2017) ISBN 978-9352605224
2.	IoT Fundamentals, 1e	Hanes	Pearson (ISBN: 9789386873743)
3.	The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World	Miller	Pearson (ISBN: 9789332552456)
4.	Internet of Things	Ramgir	Pearson (ISBN: 9789353438944)
5.	internet of Things: A Hands-On Approach	Arsheep Bahge and Vijay Madisetti	Orient Blackswan Private Limited - New Delhi; First edition (2015) ISBN : 978-8173719547
6.	Internet of Things	Dr. Jeeva Jose	Khanna Publishing House (Edition 2017)
7.	The Internet of Things: Enabling Technologies, Platforms, and Use Cases	Pethuru Raj and Anupama C. Raman	CRC Press

Resources:

1. https://www.raspberrypi.org/blog/getting-started-with-iot/
2. https://www.arduino.cc/en/IoT/HomePage
3. https://www.microchip.com/design-centers/internet-of-things
4. https://learn.adafruit.com/category/internet-of-things-iot
5. https://nptel.ac.in/noc/individual_course.php?id=noc17-cs22
6. Research papers

Name of the course: Mobile Communication	
Course Code: ETCE/DMC/S5	Semester: Fifth
Duration: One Semester(Teaching-15 Weeks + Internal Exam-2 weeks)	Maximum Marks:100 Marks
Teaching Scheme:	**Examination Scheme**
Theory:3contact hours/ week	Class Test(Internal Examination):20 Marks
Practical:3contact hours/week	Attendance=10 marks and Quizzes/Assignment/Student Activity=10 marks
	End Semester Examination: 60 Marks
Credit:4(TH:3+PR:1)	Practical:100 Marks
Course Outcomes:	

On completion of the course students will be able to:

- State about Basic Terminologies and functions of mobile Communication system
- Analyze the Progression of Cellular Telephone System
- Explain about GSM, GPRS, PCSS and EDGE
- Describe the concept of Antennas used in mobile Communication system

Content(Name of the topic)		Periods
	Group – A	
Unit 1	**FUNDAMENTAL OF MOBILE COMMUNICATION**	**10**
	1.1 Personal communication system -Wireless local area network -Wireless broadband access system- Wireless wide area network. 1.2 Basic Terminologies related to Cellular Communication: Mobile Station, Base Station, Control channel, Forward and reverse channel, MSC, MTSO, PSTN. 1.3 Basic Cellular Communication Architecture. 1.4 Initialization of Cellular Calls between Mobile Station to Mobile Station, and Landline Phone to Mobile Station - Timing Diagrams illustrating how a call initiated by a mobile and landline phone users.	
Unit 2	**CELLULAR CONCEPTS**	**10**
	2.1 Features of Cellular system - shapes of cell, Frequency reuse, Co-channel interference - Adjacent channel interference - Cell splitting -Sectoring -Segmentation and Dualization. 2.2 Concept of Roaming and Hands-off Strategies, Call drop and avoidance strategies. 2.3 Types of hands-off Strategies: Hard Hands-off -Soft Hands-off- Mobile assisted hands-off.	
Unit 3	**CELLULAR TELEPHONE SYSTEM**	**10**
	3.1 Features of 1st Generation Analog cellular Telephone- AMPS Frequency allocation. 3.2 Features of 2nd Generation Cellular Telephone System – Basic ideas of N-AMPS and Digital Cellular Telephone-Advantages of 2G over 1G. 3.3 Features of 3rd Generation Cellular Telephone System - Advantages of 3G over 2G 3.4 Features of 4th Generation Cellular Telephone System- Features of LTE & VOLTE and their difference – features of WIMAX-Application of 4G- Advantages over 4G over 3G. 3.5 Features of 5thGeneration Cellular Telephone System –Application of 5G- Advantages over 5G over 4G.	
	Group – B	
Unit 4	**Global System For Mobile Communication (GSM)**	**09**
	4.1 Features of GSM services. 4.2 GSM Architecture: Mobile Station-Base Station Subsystem (BTS, BSC)-Networking Switching Subsystem(HLR, MSC, VLR,AUC,EIR)-Operational support subsystem. 4.3 General Packet Radio System (GPRS): Concept -Services offered –benefits. 4.4 Idea of Enhanced Data rates for Global Evolution (EDGE) 4.5PCSS (Personal Communication Satellite system) –Basic concept, Advantages and disadvantages.	
Unit 5	**Antenna used in mobile Phone**	**06**
	5.1 Working principle of Mobile Phone Antenna –Working of PIFA (Planar Inverted F Antenna) –Location of antenna in mobile set 5.2 selection of antenna for reducing SAR (Specific Absorption Rate), Microstrip Antenna. 5.3 Antenna Used in Mobile Tower - Types and features	
	Total	**45**

Sl. No.	Suggested List of Laboratory Experiments
1	To study Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, Base Station, Control channel, Forward and reverse channel, MSC, MTSO, PSTN (by using virtual lab).
2	Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
3	To study transmitters and receiver sections in mobile handset and measure frequency band signal.
4	Demonstrate the impact the received power levels for hand-off in case of mobile cellular communication using fading channel mobile communication virtual lab.
5	Estimate the impact of sectoring in increasing cellular system capacity using fading channel mobile communication virtual lab.
6	Study the GPRS system and use it for sending an e-mail through WI-GPRS trainer.
7	Study the GSM modem and its different module for phone book, setting up a call, sending SMS and identifying call history using AT commands.

References:

Sl No.	Title of Book	Author	Publication
1.	Wireless Communications Principles and Practice	Theodore S. Rappaport	2nd Edition, Pearson Education, 2003
2.	Mobile Wireless Communication	Mischa Schwartz	Cambridge publication
3.	Mobile Communications	Jochen Schiller	2nd Edition, Pearson Education
4.	Principle and Application of GSM	V.K.Garg, J.E.Wilkes	Pearson Education, 5th edition
5.	Wireless Digital Communications	Kamilo Feher	PHI, 2003
6.	Mobile Cellular Communications	W.C.Y. Lee	2nd Edition, MC Graw Hill, 1995
7.	Mobile Communication Paperback – 1 January 2013	Brijesh Verma	

Resources:

1. http://nptel.ac.in/courses/

Name of the course: Industrial Electronics	
Course Code: ETCE/DIE/S5	Semester: Fifth
Duration: One Semester(Teaching-15 Weeks + Internal Exam-2 weeks)	Maximum Marks:100 Marks
Teaching Scheme:	**Examination Scheme**
Theory:3contact hours/ week	Class Test(Internal Examination):20 Marks
Practical:3contact hours/week	Attendance=10 marks and Quizzes/Assignment/Student Activity=10 marks
	End Semester Examination: 60 Marks
Credit:4(TH:3+PR:1)	Practical:100 Marks
Course Outcomes:	

On completion of the course students will be able to:

- Interpret the performance of different types of Power Semiconductor Devices
- Implement different types of controlled rectifiers
- Compare the performance of different types of Power Supply
- Analyze the operation of various converters, inverters, choppers, regulators etc.
- Illustrate the speed control methods of different types of motors.

Content(Name of the topic)		Periods
	Group – A	
Unit 1	**Power Semiconductor Devices**	**06**
	1.1 Principle of operation, VI characteristic and switching characteristics, Applications: Power Diode, Power Transistor, MOSFET and IGBT 1.2 Concept of thermal resistance, heat sink and thermal equivalent circuit 1.3 Concept of protection of Power Semiconductor Devices: MOV and Snubber	
Unit 2	**Thyristor**	**12**
	2.1 Switching characteristics & Two transistors method of SCR, Ratings of SCR 2.2 Triggering circuits of SCR 2.3 Need for series and parallel methods of SCR. Reasons of unequal voltage and current distribution and equalization networks 2.4 Family devices - Photosensitive SCR, GTO, SCS, TRIAC & DIAC 2.5 Commutation circuits of SCR – natural and forced commutation – Class A, B, C, D and Class E	
Unit 3	**Single phase &Polyphase controlled rectifier**	**08**
	3.1 Single phase half wave and full wave control rectifier circuit – Principle of operation with resistive and inductive load – Use of free wheel diode. Calculation of Vdc 3.2 Three phase half wave and full wave control rectifier – Operation with inductive and resistive load. Calculation of Vdc 3.3 Concept of full control and half control rectifier	
	Group – B	
Unit 4	**Application of SCR in Power Supply**	**04**
	4.1 Switching Regulator (SMPS) principle of operation, Block and circuit diagram and PWM control circuit consideration of switching regulator 4.2 Advantage and disadvantage of switching regulator in comparison with linear regulator 4.3 Principle of operation of ON-line UPS and OFF-line UPS	
Unit 5	**Converters**	**10**
	5.1 Chopper - Principle of operation with an example (Jone's chopper) and its application 5.2 Inverters - Voltage source inverter and current source inverter; Single Phase Half bridge and full bridgeinverter; Three phase inverter; Applications of inverters 5.3 Principle of operation of Cycloconverter and its applications 5.4 Dual Converter and its applications 5.5 AC Power Regulators - Phase Control AC Regulator, Sequence Control of AC Regulators	

Unit 6	SPEED CONTROL OF MOTORS	05
	6.1 TYPES OF SPEED CONTROL OF DC MOTOR: Armature Voltage Control, Field Current Control, Quadrant Drive 6.2 Types of speed variation of AC Motor- Frequency variation, Stator volt variation	
	Total	**45**

Sl. No.	Suggested List of Laboratory Experiments
1	To measure the reverse recovery time and softness factor of a diode
2	To plot V/I characteristics of SCR
3	To plot V/I characteristics of Triac.
4	To plot V/I characteristics of Diac
5	To study the operation of a triggering circuit of SCR
6	To study the operation of a single phase rectifier—output waveform with phase control circuit
7	To study the operation of a polyphase rectifier
8	To study the operation of SMPS
9	To study the operation of a phase control AC regulator
10	To study the operation of a Jones chopper
11	To study the operation of an Online UPS system
12	To study the operation of a single-phase bridge inverter with resistive load
13	To study the speed control of DC motor by: — (a) varying field current keeping armature voltage constant; and, (b) varying armature voltage keeping field current constant
14	To study speed control of an induction motor by voltage and frequency variation

References:

Sl No.	Title of Book	Author	Publication
1.	Power Electronics	Dr. S K Mandal	TMH
2.	Industrial Electronics	Khan &Chandani	TMH
3.	Industrial Electronics	Biswanath Pal	PHI
4.	Power Electronics	H Babu	Scitech
5.	Power Electronics	Moorthi	OXFORD
6.	Industrial Electronics	S N Biswas	Dhanpat Rai
7.	Modern Power Electronics	P C Sen	S Chand
8.	Power Electronics- Circuits, Devices and Applications	Muhammad H Rashid	Pearson
9.	Industrial Electronics	Chatterjee & Bhattacharya(TTTI)	TMH
10.	Power EllectroniicsConvertter Applliicattiion and Desiign	Mohan	Wiley

Name of the course: Medical Electronics	
Course Code: ETCE/DME/S5	Semester: Fifth
Duration: One Semester(Teaching-15 Weeks + Internal Exam-2 weeks)	Maximum Marks:100 Marks
Teaching Scheme:	**Examination Scheme**
Theory:3contact hours/ week	Class Test(Internal Examination):20 Marks
Practical:3contact hours/week	Attendance=10 marks and Quizzes/Assignment/Student Activity=10 marks
	End Semester Examination: 60 Marks
Credit:4(TH:3+PR:1)	Practical:100 Marks

Course Outcomes:

On completion of the course students will be able to:

- Acquire the knowledge of bio-electric potential
- Familiar with bio-medical Instrumentation
- Introduce the student to the electronic devices and theory of operation in the medical area
- Apply knowledge of engineering and science to understand the principle of biomedical electronic circuits
- Introduce the student to the electronic devices for medical imaging

Content(Name of the topic)		Periods
	Group – A	
Unit 1	**Bio-potential**	**05**
	1.1 Introduction to cell, Structure of cell membrane, excitable cells, definition of Bio-potential, Membrane potential, Resting membrane potential, Cause of Resting membrane potential, Nernst equation for Equilibrium electric potential, Goldman equation for membrane potential, Action potential, Different phenomenon of action potential, action potential wave form, Propagation of action potential. 1.2 Bio-medical signals - Non-electric bio-medical signal and introduction to bio-electric signals & their sources. Introduction to ECG, EEG, EMG, ERG	
Unit 2	**Basic Concept of Bio-medical Instrumentation**	**04**
	2.1 Different types of bio-medical instrument, Generalized bio-medical instrumentation system - Basic block diagram, different functional units such as electrodes, transducer/ sensor, bio-amplifier, filter, display, recorder, alarm, controlling system, memory.	
Unit 3	**ECG**	**06**
	3.1 Definition of ECG, Electro-physiology of heart, ECG amplifier, ECG electrodes and its placement, ECG leads, Basic block diagram of ECG machine, HR measurement	
	Group – B	
Unit 4	**Blood pressure measurement**	**05**
	4.1 definition of blood pressure, arterial blood pressure, Systolic pressure, Diastolic pressure, pulse pressure, mean pressure, Indirect BP measurement method, Principle of Auscultatory method 4.2 Working of Electronic BP instrument, Working principle of Direct BP measurement.	
Unit 5	**Medical Laboratory Instrument**	**04**
	5.1 Introduction to photometry, Bear-Lambert's law. Working, block diagram, application of Colorimeter, Clinical Bio-chemistry analyzer, Cell counter	
Unit 6	**Cardiac Pacemaker and Defibrillator**	**04**

	6.1 Pacemaker & its necessity, Working principle of Synchronous and Asynchronous pacemaker with block diagram, Implantable Pacemaker. Defibrillator, Working principle of Defibrillator with block diagram. Application of Defibrillator	
Unit 7	**Patient Monitoring System**	**03**
	7.1 Introduction to ICU, Working of bed side patient, different clinical parameter, Centralized patient Monitoring system	
Unit 8	**Electro-surgery Machine**	**02**
	8.1 Working principle of electro-surgery machine, Cutting & coagulation mode, Electro-surgery circuit, electro-surgery Safety	
	Group – C	
Unit 9	**Electrical safety**	**04**
	9.1 Introduction to Electric shock hazard in electro-medical Instrument, Macro shock, micro shock, Physiological effects of Electric Shock, Leakage current, Earth leakage current, Enclosure leakage current, Patient Leakage current, Patient safety precaution	
Unit 10	**Medical imaging**	**05**
	10.1 X-ray, Working of X-ray machine with block diagram, Computed radiography (CR) system, Digital radiography (DR), Ultrasound, Working principle of Ultrasound imaging system, Different modes of Ultrasound. Principle of CT image formation, Principle of MRI	
Unit 11	**Introduction to bio-telemetry**	**03**
	11.1 Definition of bio-telemetry, Wireless bio-telemetry, Single channel bio-telemetry, Multi-channel Bio-telemetry	
	Total	**45**

Sl. No.	**Suggested List of Laboratory Experiments**
1	Study of ECG amplifier circuit.
2	Recording of ECG
3	Study of electronic BP instrument circuit.
4	Blood Pressure measurement
5	Measurement of OD and concentration of unknown solution using colorimeter
6	Study of working of clinical bio-chemistry analyzer
7	Study of blood cell counter
8	Study of bed side patient monitor
9	X-ray imaging
10	Verification of bio-telemetry

References:

Sl No.	**Title of Book**	**Author**	**Publication**
1.	Handbook of Biomedical Instrumentation	R.S. Khandpur	Tata McGraw Hill
2.	Handbook of Biomedical Instrumentation	H.E. Thomas	Prentice Hall of India
3.	Biomedical instrumentation and Measurement	L. Cromwell, F.J. Weibell & E.A. Peiffer	Prentice Hall of India
4.	Electronics for Biomedical Personnel	E.J.B.	BucksteinTaraporewala
5.	Biomedical Instrumentation	Can & Brown	

6.	X-ray techniques for students	M.O. Chasney	
7.	Recent Advances in Biomedical Engineering	Reddy	

Name of the course: **Project**	
Course Code: ETCE/PRO/S5	Semester: Fifth
Duration: 15 Weeks	Maximum Marks: 100 Marks
Credit: 2	

Course Outcomes:

On completion of the course students will be able to :

- Work in Groups, Plan the work, and Coordinate the work.
- Develop leadership qualities.
- Analyse the different types of Case studies.
- Develop Innovative ideas.
- Develop basic technical Skills by hands on experience.
- Write project report.
- Develop skills to use latest technology in Electronics field.

Contents:

During fifth semester students will collect information, analyze the information and select the project. They will also prepare the List of the components required, PCB design, Testing Procedure, Design of the Cabinet or Box or Board as the case may be. They will also prepare a synopsis of the project.

So at sixth semester they have to execute the project. A tentative Schedule is proposed below:

Proposed Schedule:

Design and testing of various electronics circuits through simulation tools like- Matlab, Multisim, Proteus etc. **(04 Weeks)**

Procuring components, component testing and circuit testing. **(02 Weeks)**

PCB making and onboard testing- i) PCB designing of electronics projects by using orcad, proteus, circuit maker etc. simulation tools. ii) Printing, etching and drilling of circuit board. iii) Soldering and disordering of components as per design. iv) PCB and hardware testing. **(06 Weeks)**

Mounting the PCB inside cabinet. **(01 Week)**

Documentation. **(02 Weeks)**

Project Work is intended to provide opportunity for students to develop understanding of the interrelationship between different courses learnt in the entire diploma programme and to apply the knowledge gained in a way that enables them to develop & demonstrate higher order skills. The basic objective of a project class would be to ignite the potential of students' creative ability by enabling them to develop something which has social relevance, aging, it should provide a taste of real life problem that a diploma-holder may encounter as a professional. It will be appreciated if the polytechnics develop interaction with local industry and local developmental agencies viz. different Panchayet bodies, the municipalities etc. for choosing topics of projects and / or for case study. The course further includes preparation of a Project Report which, among other things, consists of technical description of the project. The Report should be submitted in two copies, one to be retained in the library of the institute. The Report needs to be prepared in computer using modern software wherever necessary.

General Guideline:

Project Work is conceived as a group work through which the spirit of team building is expected to be developed. Students will be required to carry out their Project Works in groups under supervision of a lecturer of their core discipline who will work as a Project Guide. It is expected that most of the lecturers of the core discipline will act as project guide and each should supervise the work of at least two groups. Number of students per group will vary with the number of lecturers acting as Project Guide and student strength of that particular class.

The Project:

The students should be made aware of the factors influencing the selection of a particular product and its available design, viz. selection of components for assembling, harnessing, testing and quality control of the same. They should also be aware of the workability of the product. Each group will take at least one project in a semester.

Project Report:

Each project work should be accompanied by a 'Project Report' which should cover the following:—
(a) Literature survey;
(b) General description;
(c) Product specification;
(d) Hardware description;
(e) Operating instruction;
(f) Installation requirement, if any;
(g) Circuit diagrams;
(h) Layout diagrams;
(i) List of components;
(j) Costing;
(k) Study of marketability;
(l) Scope for future development;
(m) A brief outline of the maintenance procedure may also be included in the report (if possible).

Suggested List of Project Works:

The project works are generally selected depending upon the objective of the course and the infrastructural facilities available at a particular institution. Some of the popular items are listed below as guideline for selection:— (i) regulated power supply; (ii) AC voltage stabilizer; (iii) inverter; (iv) battery charger; (v) FM receiver; (vi) bar level indicator; (vii) digital thermometer; (viii) field strength meter; (ix) digital clock; (x) solid state relay; (xi) stereo amplifier; (xii) Solar appliances like solar lantern, solar inverter, solar mobile/battery charger etc. (xiii) programmable interval time; (xiv) analog trainer kit; (xv) digital trainer kit; (xvi) circuit theory trainer kit; (xvii) microprocessor trainer kit; (xviii) telephone line / status monitor; (xix) MICROCONTROLLER BASED APPLICATIONS: (a) temperature controller, (b) alarm, (c) moving display, (d) speed control of motor, (e) programmable logic controller etc.; (xx) one project on computer application ; (xxi) one project on any one of the elective subjects; (xxii) real time embedded systems; (xxiii) Project on Internet of Things (xxiv) Any other suitable project referred from relevant books/ journals or emerging areas of electronics and communication technology after thorough review of the literature from internet.

References:

1. Any Journal Related to Electronics/Computer/Information Technology
2. https://www.pinterest.com
3. https://www.electronicsforu.com
4. https://www.electronicshub.org
5. https://www.elprocus.com

Name of the course: **Internship-II**	
Course Code: ETCE/INT-II/S5	Semester: Fifth
Duration: During vacation(3-4 weeks)	Maximum Marks: 100 Marks
Credit: 1	

Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry. In case students want to pursue their family business and don't want to undergo internship in any industry, a declaration by a parent may be submitted directly to the TPO and he/she has to submit a detailed project report on entrepreneurial activities.

OR Students may choose Rural/ Social Internship Programme: Various initiatives in a rural belt for technological intervention and networking for holistic transformation of the rural population by identifying the possibilities of localized employment, convergence, cost reduction, Youth and Women empowerment etc and he/she has to submit a detailed report to faculty mentor/TPO/NSS head for evaluation.

Course Outcomes:

On completion of the course students will be able to :

- Understand the real time industrial environment.
- Get exposure about entrepreneurship development.
- Learn about the training and simulation program of the industry.
- Handle different Industrial equipments/machineries with latest technology.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Expose the students to future employers.
- Creating network and social circle and developing relationships through upliftment of the society.