DIPLOMA WING

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA,BHOPAL

SCHEME OF STUDIES & EXAMINATIONS (IMPLEMENTED FROM SESSION : JULY 2023)

SCHEME	NAME OF BRANCH	BRANCH CODE	SEMESTER
OCBC JULY 2022/2023	ET & TELECOMMUNICATION	E03	FIFTH (V)

S.N.	PAPER CODE	SUBJECT CODE	SUBJECT NAME	THEORY COMPONENT								PRACTICAL COMPONENT					TOTAL CREDITS	TOTAL MARKS
				HRS PER WEEK	CREDITS	QUIZ/ASSIGNMENT	MID TERM TEST*		TOTAL	MARKS	DURATION	HRS PER WEEK	CREDITS	LAB WORK	MARKS	DURATION		
							I	II		(THEORY PAPER)					(PRACTICAL EXAM/VIVA)			
1	7466	501	EMBEDDED SYSTEM	4	4	10	10	10	30	70	03 Hrs.	4	2	20	30	03 Hrs.	6	150
2	7467	502	MOBILE & WIRELESS COMMU.	4	4	10	10	10	30	70	03 Hrs.	4	2	20	30	03 Hrs.	6	150
3	7468	511	INDUSTRIAL AUTOMATION OR	3	3	10	10	10	30	70	03 Hrs.	2	1	20	30	03 Hrs.	4	150
	7469	512	CONTROL SYSTEM & PLC															
4	7470	521	MICROWAVE & RADAR OR	3	3	10	10	10	30	70	03 Hrs.	0	0	0	0	0	3	100
	7471	522	SEMICOND.PKG. & TESTING															
5	7601	531	RENEWABLE ENERGY TECH. OR	3	3	10	10	10	30	70	03 Hrs.	0	0	0	0	0	3	100
	7602	532	INTERNET OF THINGS															
6			SUMMER INTERNSHIP-II**	0	0	0	0	0	0	0	0	0	3	20	30	03 Hrs.	3	50
7			MAJOR PROJECT***	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
8			RECOVERY CLASSES/LIBERARY etc.	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0
			TOTAL	17	17				150	350		19	8	80	120		25	700

NOTE - (1)* Two Best, out of Three Mid Term Tests (Progressive Tests) Marks should be entered here.

(2)** 4-6 Weeks Summer Internship after IV Semester.

(3)***One Credit will be carried forward to the Six semester major project evaluation.

GRAND TOTAL OF CREDITS	GRAND TOTAL OF MARKS
25	700

COURSE TITLE	:	EMBEDDED SYSTEM
PAPER CODE	:	7466
SUBJECT CODE	:	501
TREORY CREDITS	:	04
PRACTICAL CREDITS	:	02

Course objective: The aim of this course is to help the student to attain the following knowledge through various teaching- learning experiences:

➢ Identify different components of embedded system and their function.
➢ Prepare embedded C program for the given application.
➢ Identify pins and ports of specified Arduino board.
➢ Configure the pins for given peripheral.

Course Content:

Unit	Topics and Sub-topics	Hours	Marks
Unit 1 Embedded C and operators for Arduino	• Embedded system: Definition, embedded system vs general computing systems, characteristics of embedded system, functional block diagram of embedded system. • Integrated Development Environment (IDE): Arduino IDE, Stepwise procedure to use IDE, functions in Arduino IDE (built-in, default, user-defined), Boot-loading concept. • Embedded C : List data types and basic operators for Arduino/Embedded C (Arithmetic, Compound, Boolean, Comparison & Bitwise Operators) • Communication interface using serial port (Arduino code to print messages on the serial monitor) • Basic program structure- Simple programming code (e.g. temperature conversion, simulation of two-way doorbell) and its output involving operation like- Arithmetic and Boolean operations, bit-wise operations, compounded operations.	16	20

Unit 2
Embedded C control structure blocks
	• Control structures in Embedded C: sequential, repetitive, selection
	• Concept of looping mechanism and branching operations, flowchart, syntax, interpret simple program for following-
	  − For loop, do while loop and while loop.
	  − If else, switch case
	• Difference between C and Embedded C language
		14	18

| Unit 3
Introduction to
Arduino Mega | General introduction to Arduino boards, comparison of performance parameters between Arduino mega, uno and nano. Brief introduction to Arduino® Mega 2560 specifications including power ratings, description of pins and ports (Analog, Digital, Serial communication ports, PWM ports and special ports) Syntax for configuring the digital pins as Input/Output and code for interfacing with- LED 7 segment display Push button Syntax for configuring analog pins as input/output and code for interfacing with- Temperature Sensor. Potentiometer Ultrasonic Sensor IR Sensor List peripherals and their application. | 16 | 18 |
| Unit 4
Communication
with Arduino | Types of data transfer in Arduino - parallel data transfer, serial data transfer – synchronous, asynchronous, half duplex, full duplex. Communication Modes (without code) UART Communication(half duplex communication, full duplex communication) SPI (Serial Peripheral Interface)Communication I2C (inter-Integrated Circuit) Communication Concept of Interrupts and Timer in Arduino Mega Commonly used module – RFID, Cellular, Bluetooth and Wi-Fi | 14 | 14 |

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EMBEDDED SYSTEM LAB

Suggested practicals/ exercises:

S. No.	Practical	Unit No.
1.	Installation of Arduino IDE and familiarizing with the interface.	1
2.	Boot loading of microcontroller.	1
3.	Write an Arduino code to print messages on the Serial Monitor through serial communication using sketch and any Arduino board.	1
4.	Write a sketch program to convert Celsius to Fahrenheit and display the result on serial monitor	1
5.	Write a sketch program to simulate two way doorbell.	1
6.	Built-in LED state control by push button sketch implementation	3
7.	Built-in LED blinking sketch implementation	3
8.	Built-in LED blinking by toggling states based on binary operation	3
9.	Built-in LED state control by user interface through serial port	3
10.	User interface for boolean operation and bit wise operation through serial port	4
11.	User interface for compounded operation through serial port	4
12.	Looping mechanism to check the state of pin and if change print its status on serial port	2
13.	Controlling multiple LEDs with a loop and an array	2
14.	Use a potentiometer to control the blinking of an LED	3
15.	Uses an analog output (PWM pin) to fade an LED.	3
16.	Servo Motor Control using PWM	4
17.	Temperature sensor interfacing and sending its reading over serial port	4

Reference Books/ Suggested Learning Resources:

S. No.	Title of Book/ Learning Resources	Author	Publication
1.	Embedded Systems	Deepa M, Susithra N, Dr G. Santhanamari	All India Council for Technical Education
2.	Introduction to Embedded Systems	K.V.Shibu	Tata Mcgraw Hill
3.	Arduino Projects For Dummies	Brock Craft	Dummies A Wiley Brand
4.	Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform	Massimo Banzi and Michael Shiloh,	Maker Media; Third edition (27 December 2014) ISBN : 978-9351109075

Suggested Software/Learning Websites:

a. https://www.arduino.cc/reference/en/

b. https://learn.adafruit.com/category/learn-arduino

c. https://ebooks.inflibnet.ac.in/csp13/chapter/microcontrollers-and-embedded-processors-2/

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COURSE TITLE	:	MOBILE AND WIRELESS COMMUNICATION
PAPER CODE	:	7467
SUBJECT CODE	:	502
TREORY CREDITS	:	04
PRACTICAL CREDITS	:	02

Course Objective: The aim of this course is to help the student to attain the following knowledge through various teaching- learning experiences:

➢ Explain components of cellular mobile architecture.
➢ Compare various mobile communication technologies.
➢ Explain factors affecting wireless propagation in mobile communication.

Course Content:

Unit	Topics and Sub-topics	Hours	Marks
Unit-1 Overview of Cellular Systems, Evolution of 2G/3G/4G/5G, Cellular Concepts	• Limitation of conventional Mobile system, Basic cellular system,advantages of cellular mobile system, Services offered in 2G/3G/4G/5G Technology, • Concept of Frequency Reuse in cellular structure, Hexagonal cells, real cells, Frequency Reuse Factor k, Hand off, co-channel interference, adjacent channel interference, Cell splitting, Cell sectorization. • Components and function of 2GCellular mobile network: MS(Mobile Set), SIM(Subscriber Identification Module), BTS (Base Trans receiver Station), BSC(Base Station Controller), MSC(Main Switching Center), O&M(Operation and Maintenance),HLR(Home Location Register), VLR(Visitor Location Register), AUC (Authentication Center), EIR(Equipment Identity Register) • Major features of GSM -2G and 3G	22	24
Unit 2 - Wireless propagation	• Definition of link budget, Free-space path loss equation, Link budget for Free-space path loss(simple numerical) • Effect of reflection, diffraction and scattering, Doppler effect • Fading, small scale fading, large scale fading, effect of Multipath • Shadowing, Fading margin, Shadowing margin	12	12

Unit 3- Antenna diversity, wireless channel capacity and MIMO	• Concept of Space diversity • Definitions of RMS Delay Spread, Coherence Bandwidth and Coherence Time • Concept of Equalization and Adaptive Equalization • Wireless Channel Shannon's Capacity formula for AWGN Channel • Introduction, Architecture, Channel Capacity, Advantage and Applications of MIMO	10	12
Unit 4- Overview of CDMA , OFDMA and LTE	• Definition, explanation, comparison and application of TDMA, FDMA, CDMA, OFDMA. • Components and functional block diagram of LTE 4G mobile network: UE (User Equipment), SIM (Subscriber Identification Module), E-UTRAN (Evolved-UMTS Terrestrial Radio Access Network), MME (Mobility Management Equipment), S-GW (Signaling Gateway), P-GW (PDN Gateway), HSS (Home Subscriber Server), PDN (Packet Data Network). • Major features of 4G and5G • Comparison between 2G/3G/4G/5G.	16	22

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MOBILE AND WIRELESS COMMUNICATION LAB

Suggested practicals/ exercises

S. No.	Practical	Unit No.
1.	To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell.	1
2.	To understand the path loss	2
3.	Understand the path loss with shadowing	2
4.	Understanding the Flat fading	2
5.	Understanding the Frequency selective fading	2
6.	Understanding the Multipath channel for the following objectives 1. No Fading 2. Flat Fading 3. Dispersive Fading	2
7.	Perform following experiments using available CDMA trainer kit/ mobile communication kit	4
8.	Study of Smart Phone	1,4

Reference Books /Suggested Learning Resources:

S. No.	Title of Book	Author	Publication
1.	Mobile and Wireless Communication	Maulin Joshi, Urvashi P. Shukla	AICTE Publication
2.	Wireless Communications – Principles and Practice	T. S. Rappaport	(2nd edition) Pearson ISBN9788131731864
3.	Modern Wireless Communication	Haykin & Moher	Pearson 2011 (Indian Edition) ISBN : 978-8131704431
4.	Mobile Cellular Communication	William C.Y. Lee	Second edition , Tata McGraw Hill
5.	Wireless Communication	Upena Dalal	Oxford University Press

Suggested Software/Learning Websites:

a. https://www.geeksforgeeks.org/difference-between-gsm-and-lte/

b. https://nptel.ac.in/courses/117104099

c. Network Cell Info Lite App

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SEMESTER V

COURSE TITLE	:	INDUSTRIAL AUTOMATION
PAPER CODE	:	7468
SUBJECT CODE	:	511
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	01

Course objective: The aim of this course is to help the student to attain the following knowledge through various teaching- learning experiences:

- Identify different components of an automation system.
- Interface the given I/O device with appropriate PLC module.
- Prepare a PLC ladder program for the given application.
- Select the suitable motor drives for the specified application

Course Content

Unit	Topics and Sub-topics	Hours	Marks
Unit 1 Industrial automation overview and data acquisition	- Need and benefits of industrial automation, Types of automation- Fixed, Programmable, Flexible - Automation hierarchy - Different levels of industrial automation – sensor level, control-level, supervision-level, enterprise-level) - Architecture of Industrial Automation Systems – Basic components of automation system with functional description. - Data Acquisition Systems (DAS): Introduction, block diagram, working principle and applications of DAS	15	20
Unit 2 Control Generation	- Introduction to Automatic Control System - Working principle, block diagram, application, limitation of- - P-I-D Control - Feed forward Control - Ratio Control - The branching operations based on conditions expression	15	15
Unit 3- Sequential control and PLC	- Introduction to Sequence Control, RLL –Relay Ladder Logic - PLC Hardware Environment-CPU, Memory, Analog and discrete Input/Output, power supply - PLC programming Language-Function Block Diagram, Instruction list, - Structured Text, Sequential Function Chart, Ladder programming - Simple Ladder programming for Traffic light control, Stepper	15	20

	motor control		

Unit 4-
Industrial
control
application
	• Working principle, block diagram, application, limitation of-
	  ▪ Hydraulic Control Systems
	  ▪ Pneumatic Control Systems
	• Energy Savings with Variable Speed Drives
	• Introduction To CNC Machines and list applications
		15	15

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INDUSTRIAL AUTOMATION LAB

Suggested practicals / exercises:

S. No.	Practical	Unit No.
1.	Develop a data acquisition system using Arduino.	1
2.	Temperature control system using PID.	2
3.	Level control system based on error feedback.	2
4.	PLC programming using Relay Ladder logic for AND, OR, XOR and NOR gate.	3
5.	PLC, RLL programming using CASCADE method.	3
6.	PLC timer, counter, registers and analog input/output functions.	3
7.	Variable speed drive of an Induction motor.	4
8.	PLS/Microcontroller based computer numerical control machine job completion.	4

Reference Books /Suggested Learning Resources:

S. No.	Title of Book	Author	Publication
1.	Industrial Instrumentation, Control & Automation	S. Mukhopadhyay, S. Sen, A K Deb	Jaico Publishing House 2013, ISBN : 978-8184954098
2.	Electric Motor drives, Modeling, Analysis & Control	R. Krishnan	Prentice Hall India 2002, ISBN – 978-0130910141

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SEMESTER V

COURSE TITLE	:	CONTROL SYSTEM AND PLC
PAPER CODE	:	7469
SUBJECT CODE	:	512
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	01

Course objective: The aim of this course is to help the student to attain the following knowledge through various teaching- learning experiences:

- Classify the Signal and System.
- Perform laplace transform and block reduction.
- Interpret time domain analysis and stability of system.
- Define the fundamental of PLC.

Course Content:

Unit	Topics and Sub-topics	Hours	Marks
Unit-1 Basics of Control System	**Signal:** • Analog, digital, deterministic, random, energy, power, odd, even, periodic and a periodic **System**: • Linear & non-linear, time variant & invariant, causal & non-causal system. **Control system:** • Basics of control system, block diagram and practical examples **Classification of control systems:** • Open Loop and closed loop systems, block diagram, practical example and comparison	08	12
Unit 2 Transfer function and Laplace transform	**Laplace Transform, Laplace transform of Basic function** **Transfer function:** • Close loop and open loop system RC, LC and RLC Circuits Differential equations and transfer functions and analysis using Laplace transform **Block diagram reduction technique:** • Need, reduction rules, Signal flow graph, rule of drawing signal flow graph from given block diagram, Mason's Gain formula	12	12
Unit 3 Time domain analysis	**Time Response: Transient and steady state response.** • Standard test inputs: impulse, step, ramp, and their corresponding Laplace transform **Analysis of first and second order control system:** • Poles and zeros S plane representation, Order of system (0, 1, 2)	13	12

	standard equations, examples and numerical problems • First order System Analysis for unit step input, concept of time constant. • Second order system Analysis for unit step input (no derivation), concept, definition and effect of damping • Time response specifications (no derivations) Tp, Ts, Tr, Td, Mp, Ess, numerical problems • **Steady state analysis:** Type 0, 1, 2 systems steady state error and error constants, numerical problems		
Unit 4 stability analysis	**Stability:** • Concept of stability, root location in S plane and analysis • stable system, unstable system, critically stable systems, conditionally stable system, relative stability **Routh's stability criterion:** • Steps and procedures to find stability by Routh's stability criteria **Composite controllers:** • PI, PD, PID controllers and their comparison.	10	12
Unit-5 Fundamental s of PLC	**PLC:** • Block diagram, classification, (fixed and modular PLCs), need and benefits of PLC in automation **Description of different parts of PLC:** • CPU function, scanning cycle, speed of execution, Power supply • Block diagram and function of each block • Memory - function and organization of ROM and RAM • Input and output modules- function, different input and output devices of PLC (only name and their uses). **PLC Installation:** • **Discrete input modules:** Block diagram, specifications of AC input modules and DC input module. Sinking and sourcing concept in DC input modules • **Discrete output modules:** Block diagram, description, specifications of AC output module and DC output modules • .**Analog input and output modules:** Block diagram, specifications • **I/O addressing of PLC:** Addressing data files, format addressing of logical address, different addressing types • **PLC Instruction set:** Relay instructions, timer and counter instruction s, data movement instructions, logical and comparison instructions • **PLC Programs:** Using Ladder programming language.	17	22

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CONTROL SYSTEM AND PLC LAB

Suggested practicals/ exercises:

S. No.	Practical	Unit No.
1.	Test the Step response of R-C (first order) circuit	2
2.	Test the Step response of R-L-C (second order) circuit	2
3.	Use PI controller to control temperature of the given process	4
4.	Use PD controller to control temperature of the given process.	4
5.	Use PID controller to control temperature of the given process	4
6.	Identify and test different parts of PLC.	5
7.	Develop ladder diagram to test the functionality of the logic gates	5
8.	Develop ladder diagram to test Demorgan's theorem	5
9.	Develop the ladder diagram for Adder and Subtractor by using PLC	5

Reference Books:

S. No.	Title of Book	Author	Publication
1	Process control instrumentation Technology	Johnson, C. D.	Prentice Hall, 8th edition, United States of America, 2014 ISBN: 978-0131194571
2	Intro. to Programmable logic control	Dunning, Gary	Cenage Learning, United States of America,2005 ISBN: 9781401884260
3	Control System Engineering	I J Nagrath, M. Gopal	New Age International Publishers
4	Modern control Engineering	Ogata, K	PHI, 5th Edition, NEW DELHI,2010 ISBN: 978812034010
5.	Programmable logic controllers and industrial automation an introduction	Mitra. Madhuchhanda, Gupta, Samaijit Sen	Penram, 1st Edition, Mumbai. 2007 ISBN: 9788 I 87972174
6.	Programmable logic controllers	Petruzella, F.D	Tata- McGraw Hill, 3n Edition, 2010 ISBN: 9780071067386
7.	Linear Control Systems	B.S. Manke	Khanna Publishers

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SEMESTER V

COURSE TITLE	:	MICROWAVE AND RADAR
PAPER CODE	:	7470
SUBJECT CODE	:	521
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	00

Course objective: The subject aims to provide the student with:
- ➢ An understanding of microwave waveguides, passive & active devices, tubes
- ➢ An understanding of various types of antennas and their performance Characteristics.
- ➢ An understanding of RADARs and its applications

Course Content:

Unit	Topics and Sub-topics	Hours	Marks
Unit 1 Introduction to Microwaves	**Microwaves :** • Introduction to Microwave, Frequency Range in microwave, Effect of Microwaves on human body, List applications of Microwaves **Transmission lines:** • Introduction to Transmission lines, Transmission lines Equivalent circuit, Primary and Secondary Constant, Characteristic Impedance (expression only) **Waveguide:** • Introduction to Waveguide, Waveguide Modes (TE, TM, TEM), Dominant modes	09	14
Unit 2 Passive & Active Microwave Devices	**Microwave Passive Components:** • Introduction, working Principle & application of: Waveguide Junctions (E- Plane Tee Junction, H- Plane Tee Junction, Magic-T Junction), Directional coupler, Circulators, Isolators **Microwave Active devices:** **Gunn Diode:** • Gunn effect, Working principle of Gunn diode (Gunn oscillation mode and LSA oscillation mode), Application of Gunn diode **Two cavity klystron & Reflex Klystrons**: • Construction, Working principle, velocity modulation, Applegate diagram **Magnetron:** • Construction, Working principle and applications	12	14
Unit 3 Introduction	**Antenna:** • Introduction of Antenna, Functions of Antenna.	09	14

to Antennas	**Define Basic Antenna parameter:** Radiation resistance, Efficiency of Antenna, Radiation pattern of an antenna, Isotropic and omnidirectional antenna, Gain & Directivity, Beam-width and Front to back Ratio, Bandwidth of an Antenna, linear polarization in Antenna, Effective height, Effective aperture. • Concept of Grounded and Un-Grounded Antenna.		
Unit 4 Types of Antenna	**Introduction, Physical structure, radiation pattern, working principle and application of Following antennas:** • Half wave dipole antenna • Folded dipole antenna • Yagi-Uda Antenna • Parabolic reflector antenna **Rectangular Micro-strip Patch Antennas**: • Introduction, Features, Advantages, Limitations and applications	06	14
Unit 5 RADAR Fundamentals	**RADAR:** • Introduction, working principle and Block diagram of RADAR, Radar Range Equation (Expression, simple numerical), Factors affecting Radar range. **Functions of RADAR** : • Detection of target, Tracking, Ranging, Range ambiguity, Range quantization & Granularity, Angular Position, **Parameters of RADAR** : • Pulse-repetition rate, Blind speed. • Principle of Doppler shift in Radar (Expression, simple numerical). • Applications of RADAR, • PPI Radar Display.	09	14

Textbook/Reference books:

S. No	Title of Book	Author	Publications
1.	Microwave And Radar Engineering	M. Kulkarni	Umesh Publications
2.	Microwaves and Radar Principles and Applications	A. K. Maini	Khanna Publishers, New Delhi
3.	Antenna and wave propagation	Satya Prakashan	K. D. Prasad

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SEMESTER V

COURSE TITLE	:	SEMICONDUCTOR PACKAGING AND TESTING
PAPER CODE	:	7471
SUBJECT CODE	:	522
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	00

Course Objective: The course deals with electronics systems packaging – a multidisciplinary area. The course will discuss all the vital features of Electronic packaging at three major levels, namely, chip level, board level and system level. This course covers the technology advancements of microelectronic packaging from design to fabrication; assembly and testing and discuss the current trends in packaging of electronic systems.

Course Content:

Unit	Topics and Sub-topics	Hours	Marks
Unit-1 Overview of Electronic Systems Packaging	• Functions of Electronic Packaging, Packaging Hierarchy • IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging • Trends and Challenges, • Factors affecting on Packaging Technology • Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging • Material for high density interconnect substrates.	09	14
Unit- 2 Electrical Issues in Packaging	• Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference • Design Process – Challenges in Electrical Design : Interconnect Capacitance, Resistance and Inductance fundamentals • Packaging Hybrid circuits -concept of hybrid circuits, packaging challenges : Resistive, Capacitive and Inductive parasitic.	08	12
Unit- 3 Chip Level Packaging	• IC Assembly - Purpose, Requirements; • IC Assembly Technologies (Concept, advantage, disadvantage) - Wire bonding, Tape Automated Bonding, Flip Chip • Wafer Level Packaging - Concept, advantage, disadvantage, wafer level burn-in and test. • Single chip packaging : functions, types, materials, processes and properties • Multi chip packaging : concept and application areas • System – in - package (SIP) : concept, advantages	10	16

Unit - 4 PCB, Surface Mount Technology and Thermal Consideration	• Printed Circuit Board : Anatomy, software tools for PCB design, Standard fabrication, Micro via Boards. • Board Assembly : Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. • Thermal Management : Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirement.	10	16
Unit -5 Testing	• Fundamental of design for Reliability, Environmental interactions • Thermal mismatch and fatigue-failures :Thermomechanically induced, electrically induced, chemically induced • Electrical Testing : System level electrical testing, Interconnection tests, Active Circuit Testing • Introduction to Design for Testability (DFT)	08	14

Textbook/Reference books:

S. No.	Title of Book	Author	Publication
1	Fundamentals of Microsystems Packaging	Tummala, Rao R.	, McGraw Hill, 2001.
2	The electronic packaging handbook	Blackwell (Ed),	CRC Press, 2000.
3	Microelectronics packaging handbook	Tummala, Rao R,	McGraw Hill, 2008.
4	Printed Circuit Boards Design and Technology	Bosshart	TataMcGraw Hill, 1988.
5.	Electronic Product Design	R.G. Kaduskar and V.B.Baru	Wiley India, 2011
6.	Printed Circuit Board	R.S.Khandpur	Tata McGraw Hill, 2005
7.	Essentials of Electronic Testing for Digital, memory & Mixed signal VLSI Circuits	Michael L. Bushnell &Vishwani D. Agrawal	Kluwer Academic Publishers.2000
8.	Digital System Testing and Testable Design	M. Abramovici, M. A. Breuer, and A.D. Friedman	Computer Science Press,1990

Suggested websites:

https://anysilicon.com/understanding-semiconductor-testing/

https://semiengineering.com/knowledge_centers/packaging/

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SEMESTER V

COURSE TITLE	:	RENEWABLE ENERGY TECHNOLOGIES
PAPER CODE	:	7601
SUBJECT CODE	:	531
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	00

Course Learning Objectives:

- To understand present and future scenario of world energy use.
- To understand fundamentals of solar energy systems.
- To understand basics of wind energy.
    - To understand bioenergy and its usage in different ways.
    - To identify different available non-conventional energy sources.

Course Content:

UNIT-I: Introduction: World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy Utilisation ; Renewable Energy Scenario in India and around the World; Potentials; Achievements/Applications; Economics of renewable energy systems.

Unit-II:Solarenergy: Solar Radiation; Measurements of Solar Radiation; Flat Plate and Concentrating Collectors; Solar direct Thermal Applications; Solar thermal Power Generation Fundamentals of Solar Photo Voltaic Conversion; Solar Cells; Solar PV Power Generation; .

Unit-III: Wind Energy: Wind Data and Energy Estimation; Types of Wind Energy Systems; Performance; Site Selection ;Details of Wind Turbine Generator; Safety and Environmental Aspects.

Unit-IV: Bio-Energy: Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Biodiesel; Cogeneration; Biomass Applications.

Unit-V: Other Renewable Energy Sources: Tidal energy; Wave Energy; Open and Closed OTEC Cycles; Small Hydro-Geo thermal Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

Reference Books:

1. O.P.Gupta, Energy Technology, Khanna Publishing House, Delhi(ed.2018)
2. Renewable Energy Sources, Twidell ,J.W.&Weir,A.,EFNSponLtd.,UK,2006.
3. Solar Energy, Sukhatme.S.P., Tata McGraw Hill Publishing Company Ltd. ,NewDelhi,1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.

5. Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, NewDelhi,2007.

6. Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B Natarajan, P Monga, TataMcGrawHill.

7. Energy and The Environment , RA Ristinen and JJ Kraushaar, Second Edition, John Willey & Sons, New York,2006.

8. Renewable Energy Resources ,JW Twidell and AD Weir, ELBS,2006.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand present and future energy scenario of the world.
CO2	Understand various methods o f solar energy harvesting.
CO3	Identify various wind energy systems.
CO4	Evaluate appropriate methods for Bio energy generations from various Bio wastes.
CO5	Identify suitable energy sources for a location.

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SEMESTER V

COURSE TITLE	:	INTERNET OF THINGS
PAPER CODE	:	7602
SUBJECT CODE	:	532
TREORY CREDITS	:	03
PRACTICAL CREDITS	:	00

Course Content:

Unit I-Introduction to Internet of Things

- Define the term "Internet of Things"
- State the technological trends which have led to IoT.
- Describe the impact of IoT on society.

Unit II-Design consideration of IoT

- Enumerate and describe the components of an embedded system.
- Describe the interactions of embedded systems with the physical world.
- Name the core hardware components most commonly used in IoT devices.

Unit III Interfacing by IoT devices

- Describe the interaction between software and hardware in an IoT device.
- Explain the use of networking and basic networking hardware.
- Describe the structure of the Internet.

SUGGESTEDLEARNINGRESOURCES:

S. No.	Title of Book	Author	Publication
1	Internet of Things	Raj Kamal	McGraw Hill Education ; First edition (10March2017) ISBN978-9352605224
2	Internet of Things :A Hands-On Approach	Arsheep Bahge and Vijay Madisetti	Orient Black swan Private Limited-New Delhi; First edition (2015) ISBN:978-8173719547

SUGGESTEDSOFTWARE/LEARNINGWEBSITES:

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. http://esp32.net/

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SEMESTER V

COURSE TITLE	:	SUMMER INTERNSHIP - II
PAPER CODE	:	--
SUBJECT CODE	:	--
TREORY CREDITS	:	00
PRACTICAL CREDITS	:	03

SUMMER INTERNSHIP - II

4-6 weeks summer internship after IVth Semester.

It should be undertaken in an Industry only.

Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

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COURSE TITLE	:	MAJOR PROJECT
PAPER CODE	:	--
SUBJECT CODE	:	--
TREORY CREDITS	:	00
PRACTICAL CREDITS	:	00 (ONE CREDIT WILL BE CARRIED FORWARD TO THE VI SEM. MAJOR PROJECT EVALUATION)

MAJOR PROJECT

It should be based on real/live problems of the
Industry/Govt./NGO/MSME/Rural Sector or
an innovative idea having the potential of a Startup.

Evaluation is based on work done, quality of report,
performance in viva-voce, presentation etc.

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