ಡಾ. ಮನಮೋಹನ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

Office of the Registrar, Central College Campus, Dr. B.R. Ambedkar Veedhi, Bengaluru – 560 001.
PhNo.080-22131385, E-mail: registrar@bcu.ac.in/registrarbcu@gmail.com

No.MSBCU/BoS/Syllabus/Science/ 109 /2026-27 Date: 29.06.2026

NOTIFICATION

Sub: Syllabus for the V & VI Semester Under Graduate Courses in the Faculty of Science -reg

Ref: 1. Government Order No. ED 166 UNE 2023 Bengaluru dated. 08.05.2024
2. Recommendations of the Boards of Studies in the Faculty of Science
3. Approval of the Academic Council in its meeting held on 08.06.2026
4. Orders of Vice-Chancellor dated.29.06.2026

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The Syllabus prepared by the Boards of Studies for the different Subjects of V & VI semester Under Graduate Courses, in the faculty of Science based on the Guidelines and Curriculum Structure issued by the Government under ref(1) have been approved by Academic Council meeting held on 08.06.2026.

Accordingly, the CBCS Syllabus for the V & VI Semester UG Courses of Science Faculty in respect of following subjects are hereby notified for implementation from the academic year 2026-27.

Sl. No.	Subjects
1.	Botany– V & VI Semester
2.	Chemistry– V & VI Semester
3.	Zoology and Genetics– V & VI Semester
4.	BoS in Fashion and Apparel Design i. FAD – V & VI Semester ii. IDD– V & VI Semester
5.	Geography– V & VI Semester
6.	Mathematics– V & VI Semester
7.	Physics – V & VI
8.	BoS in Home Science i) Home Science – V & VI ii)Nutrition & Dietetics – V & VI iii)Clinical Nutrition & Dietetics – V & VI iv)Food Technology – I & II Sem

p.t.o

9.	Criminology and Forensic Science– V & VI
10.	Psychology– V & VI Semester
11.	Electronics – V & VI
12.	Statistics – V & VI
13.	Microbiology– V & VI
14.	Biotechnology– V & VI
15.	Environmental Science– V & VI

The detailed Syllabi for above subjects are notified in the University Website: www.bcu.ac.in for information of the concerned.

REGISTRAR

Copy to;

1. The Registrar(Evaluation), Dr. Manmohan Singh Bengaluru City University
2. The Dean, Faculty of Science, MSBCU.
3. The Principals of the concerned affiliated Colleges of MSBCU- through email.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), MSBCU.
5. Office copy / Guard file / University Website: www.bcu.ac.in

ಡಾ. ಮನಮೋಹನ್ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

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BE BOUNDLESS

DR. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

Curriculum for Final Year B.Sc. (ELECTRONICS)
(*According to SEP – 2024 Regulations*)

Subject: ELECTRONICS
(2026 – 27 *Onwards)*

Dr. Manmohan Singh Bengaluru City University
Bengaluru – 560009

May / June – 2026

CONTENTS

PROCEEDINGS OF BoS MEETING

Proceedings of the Board of Studies (BoS) in Electronics (UG) meeting held on May 18th 2026 in Vijaya College, R V Road, Basavangudi, Bengaluru-560004.

The members were present for the meeting are:

Sl. No.	Name	Designation	Signature
1	Dr. Naveen Kumar S K Senior Professor& Chairman, Department of Electronics, Mangalore University, Mangalore-574199	Chairman	
2	Dr. M Subramanya Bhat Associate Professor& Principal, Vijaya College, R V Road, Bengaluru-560004	Member	
3	Smt. V Madhumathi Associate Professor &Head, Department of Electronics, MES Degree College, Malleswaram, Bengaluru-560010	Member	Consented
4	Sri. Vijay Kumar A Patil Associate Professor&Head, Department of Electronics, Basaveshwara College of Commerce, Arts and Science, II Block, Rajajinagar Bengaluru-560010	Member	Consented
5	Sri. K G Lakshminarayana Associate Professor, Department of Electronics, Vijaya College, Jayanagar, Bengaluru-560011	Member	
6	Dr. Mohana H K Associate Professor, Department of Electronics, Seshadripuram First Grade College, Yelahanka New Town, Bengaluru-560064	Member	
7	Ms. Jyothi V Associate Professor, Department of Electronics, Vijaya College, R V Road, Bengaluru-560004	Member	
8	Smt. Akhilandeswari R Associate Professor& Head, Department of Electronics, Sindhi Degree College, Hebbal, Bengaluru	Member	
9	Sri. Parthasarathi N Associate Professor, Department of Electronics, Govt. First Grade College, K R Puram, Bengaluru	Member	
10	Dr. Mohan Keshava K K Associate Professor& Head, Department of Electronics, Maharani Cluster University, Palace Road, Bengaluru	Member	Consented

In the beginning, Chairman extended warm welcome to all the BoS members and thanked them for accepting the assignment.

The agenda of the meeting: framing of syllabus for V & VI Semester B.Sc. Electronics (UG) under SEP-2024 was taken for discussion. After thorough discussions the following resolutions were made.

Resolutions:

1. The suggested model course structure for the UG Degree of Dr. Manmohan Singh Bengaluru City University under SEP-2024 Scheme for the academic year 2026-27 and onwards was discussed and approved.
2. Syllabus and scheme for the Fifth and Sixth semester B.Sc. degree
3. in Electronics was prepared and discussed. The board resolved to approve fifth and sixth semester syllabus to be implemented effective from 2026-27 batch and onwards.
4. Question paper pattern for both theory and practical, scheme of evaluation/assessment and award of IA marks were discussed and approved.
5. It was resolved that number of students for practical shall be TEN students per batch as Electronics is applied subject.

Finally Dr. M Subramanya Bhat, principal Vijaya College extended vote of thanks to all the BoS Members for their active participation.

Chairman

Preamble

This model curriculum content for B.Sc. Electronics as per SEP-2024 is intended to enable the graduates to respond to the current needs of the industry and equip them with skills relevant for national and global standards. The framework encourages innovation in teaching-learning process and appropriate assessment of student learning levels.

Introduction

B.Sc. Electronics is a program which needs to develop a specialized skill set among the stake holders to cater to the need of industries. The curriculum is designed to help students to analyse, appreciate, understand and critically engage with learning of the subject and also to provide better learning experience to the stake holders. Apart from imparting disciplinary knowledge, the curriculum is aimed to equip the students with competencies like problem solving and analytical reasoning which provide them high professional competence. The University is expected to encourage its faculty concerned to make suitable pedagogical innovations, in addition to teaching learning processes suggested in the model curriculum, so that the Course/Programme learning outcomes can be achieved.

Significance of Electronics

Nowadays, Electronics has made unprecedented growth in terms of new technologies, new ideas and principles. The research organizations and industries that work in this frontier area are in need of highly knowledgeable, skilled and scientifically oriented manpower. This manpower can be available only with flexible, adaptive and progressive training programs and a cohesive interaction among the institutions, universities and industries.

The key areas of study within Electronics subject comprise: Semiconductor devices and its application, Analog and digital circuit design, Microprocessors & Microcontroller systems, Computer coding / Programming in high level languages etc. and also modern applied fields such as Embedded systems, Data communication, Robotics, Control systems, IoTs, etc,.

Program Objectives

The overall objectives of the B.Sc. Electronics program are to:

- Provide students with learning experiences that develop broad knowledge and understanding of key concepts of electronics and equip students with advanced scientific / technological capabilities for analyzing and tackling the issues and problems in the field of Electronics.

- Develop ability in students to apply knowledge and skills acquired to solve specific problems in Electronics.

- Develop abilities in students to design and develop innovative solutions for the benefit of society.

- Provide students with skills that enable them to get employment in various organisations, industries, pursue higher studies, research assignments and turn as entrepreneurs.

Program outcomes

- Ability to apply knowledge of logical thinking and basic science for solving Electronics related problems.

- Ability to perform Electronics experiments, as well as to analyse and interpret data.

- Ability to design and manage Electronic systems or processes that conforms to a given specification within ethical and economic constraints.

- Ability to identify, formulate, analyse and solve the problems in various sub disciplines of Electronics.

- Ability to use Modern Tools / Techniques.

Dr. Manmohan Singh Bengaluru City University

Program Structure

(Discipline: ELECTRONICS) - Semesters 5 – 6

Semester	Title of the Paper	Credits
5	**Paper 5:** Electronic Instrumentation	3
	Paper 5 Lab: Instrumentation & PIC Microcontroller Lab	2
	Paper 6: Programming using PIC Microcontroller	3
	Compulsory Practical 2: Interfacing Sensors with Aurdino	2
6	**Paper 7:** Microwave Devices & Artificial Intelligence	3
	Paper 7 Lab: IoT Lab	2
	Paper 8: IoT and Robotics	3
	Compulsory Practical 3: Project Lab	2

Program Pattern and Scheme of Examination for B.Sc. in Electronics

Sl. No.	Semester	Title of the Paper	Teaching Hours	Hours / week		Examination Pattern Max. & Min. Marks /Paper						Duration of Exam (Hours)		Total Marks / paper	Credits	
						Theory			Practical							
				Theory	Practical	Max.	Min.	IA	Max.	Min.	IA	Theory	Practical		Theory	Practical
1	**5**	***Electronic Instrumentation***	**56**	**4**		**80**	**32**	**20**				**3**		**100**	**3**	
	5	***Instrumentation & PIC Microcontroller Lab***	**45**		**3**				**40**	**16**	**10**		**3**	**50**		**2**
	5	***Programming using PIC Microcontroller***	**56**	**4**		**80**	**32**	**20**				**3**		**100**	**3**	
	5	***Interfacing Sensors with Aurdino***	**45**		**3**				**40**	**16**	**10**		**3**	**50**		**2**
2	**6**	***Microwave Devices & Artificial Intelligence***	**56**	**4**		**80**	**32**	**20**				**3**		**100**	**3**	
	6	***IoT Lab***	**45**		**3**				**40**	**16**	**10**		**3**	**50**		**2**
	6	***IoT and Robotics***	**56**	**4**		**80**	**32**	**20**				**3**		**100**	**3**	
	6	***Project***	**45**		**3**				**40**	**16**	**10**		**3**	**50**		**2**

Scheme of Internal Assessment Marks: **THEORY**

Sl. No.	**Particulars**	**IA marks**
1	Internal Tests (Minimum of Two)	**10**
2	Assignments /Seminar / Case Study / Project work / Reports on - visits to industries/exhibitions/science centre / active participation in Electronics competitions, etc.	**10**
	TOTAL Theory IA Marks	**20**

Scheme of Internal Assessment Marks: **PRACTICAL**

Sl. No.	**Particulars**	**IA marks**
1	Practical Tests	**05**
2	Report on datasheet of electronic devices / Seminar on electronics experiments/ Active participation in practical classes	**05**
	TOTAL Practical IA Marks	**10**

Syllabus for Core Subjects

Course Title: Electronics	Course Credits: 3
Total Contact Hours: 56 Hrs	Duration of ESA: 4 Hrs
Formative Assessment Marks: 20 marks	Summative Assessment Marks :80 marks

Course Outcomes (COs)

CO1: Explain the principles of measurement systems, performance characteristics of instruments, measurement errors, and the operating principles of various transducers used for electrical and non-electrical measurements.

CO2: Analyze the construction, characteristics, and applications of different types of sensors and actuators used in industrial automation, instrumentation, and control systems.

CO3: Describe the generation of bio-potentials, electrode configurations, and the operation of bio-amplifiers used for biomedical signal acquisition and conditioning.

CO4: Apply appropriate techniques for measuring physiological and non-electrical parameters such as temperature, respiration, pulse rate, blood pressure, blood flow, and cardiac output using biomedical instrumentation.

Course Outcomes Mapped to Units

Unit	Course Outcome
Unit 1	**CO1:** Explain measurement systems, instrument characteristics, measurement errors, and the operating principles of various transducers for engineering measurements.
Unit 2	**CO2:** Analyze the working principles, characteristics, and applications of sensors and actuators used in instrumentation and automation systems.
Unit 3	**CO3:** Describe bio-potential generation, electrode configurations, and bio-amplifier circuits used in biomedical instrumentation.
Unit 4	**CO4:** Apply biomedical measurement techniques for monitoring physiological parameters including temperature, blood pressure, respiration, pulse rate, blood flow, and cardiac output.

Paper 5: Electronic Instrumentation 56 Hrs

Content

Unit 1 **15 Hrs**

Measurement System: Introduction to general measurement system, significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems.

Instruments Performance Characteristics: Definitions and problems as applicable.

Static Characteristics-Static error, static correction, scale range and scale span, reproducibility and drift, repeatability, Signal to noise ratio, sources of noise, accuracy, precision, linearity, hysteresis, threshold, dead time.

Dynamic Characteristics-Fidelity, frequency response, dynamic error, etc.,

Measurement Errors: Introduction, gross errors and systematic errors, absolute and relative errors, basic concepts of accuracy, precision, resolution.

Transducers: Classification of transducers, basic requirement of transducers, principle of operation and construction details of resistive, inductive, capacitive, temperature, ultrasonic, photoelectric, pressure, fiber optic and MEMS based transducers. Measurement techniques for motion, seismic, flow, level, humidity, pH, viscosity.

Unit 2 14 Hrs

Sensors and Actuators: Sensors-Introduction to sensors, types of sensors, typical application of sensors, basic principles and operations of Thermal Sensors, Optical Sensors, Acoustic Sensors, MEMS, Nano-sensors, Ultrasonic Sensors, Thin Film Sensors, Liquid Level Sensors, Magnetic Sensors, Radiation Sensor

Actuators-Introduction to actuators, types of actuators, Logical and Continuous Actuators, Pneumatic actuator, Electro-Pneumatic actuator, cylinder, rotary actuators.

Unit 3 14 Hrs

Bio Potential Electrodes: Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half cell potential, impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.

Electrode Configurations: Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG – unipolar and bipolar mode.

Bio Amplifier: Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier.

Unit 4 14 Hrs

Measurement Of Non-Electrical Parameter: Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

Immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

Reference Books

1 Electronic Instrumentation, H S Kalsi, TMH, 2nd Edition, 2010
2 Electronic Instrumentation and Measurements, David A Bell, PHI/ Pearson Education, 2nd Edition, 2012.
3 Modern Electronic Instrumentation and Measurement techniques, Albert D Helfrick, William D Cooper, PHI, 2007.
4 Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, DhanpatRai& sons, 18th Edition
5 Patranabis D, "Sensors and Transducers", Wheeler publisher, 1994
6 Instrumentation measurement and analysis, Nakra, Choudhary
7 John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004
8 Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
9 Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
10 Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.
11 Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGra-Hill Publisher 2003

Course Title: Practical Instrumentation & PIC Microcontroller Lab	Course Credits: 2
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 10 marks	Summative AssessmentMarks: 40 marks

Course Outcomes (COs):

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

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fieldsof electronics both in industries and research.
2. To acquire experimental skills, analysing the results and interpret data.
3. Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets/ systems / processes that conforms to a given specification within ethical and economic constraints.
4. Capacity to identify and implementation of the formulae to solve the electronic related issues and analyse the problems in various sub disciplines of electronics.
5. Capability to use the Modern Tools / Techniques.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with ProgramOutcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**
Aptitude to apply Logic thinking and Basic Science knowledge forproblem solving in various fields of electronics both in industries and research						
To acquire experimental skills, analysing the results and interpret data.	**x**					
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various subdisciplines of electronics.						
Capability to use the Modern Tools / Techniques.						

Paper 5 Lab: **Instrumentation & PIC Microcontroller Lab**
(Hardware implementation and Analysis of Circuit using Simulation Software)

PART-A (INSTRUMENTATION SYSTEMS PRACTICAL)

1. Study of the characteristics of thermistors
2. Study of the characteristics of LDR
3. Study of the piezo electric transducer
4. Construction and study the VI characteristics of solar cell
5. Conversion of basic ammeter into multimeter and calibration of voltage, resistance and current
6. Calibration of thermistors for temperature measurement.
7. Characterize the Temperature sensor (RTD)
8. Simulate the performance of a bio Sensor.
9. Measurement of level in a tank using capacitive type level probe.
10. Characterize the LVDT
11. Design an orifice plate for a typical application.
12. Simulate the performance of a chemical sensor.
13. Characterize the strain guage sensor.
14. Characterize the temperature sensor (Thermocouple).

Part – B: Interfacing with PIC18F458 Microcontroller (Programs to be written using C)

1. Interfacing of switch/s and LED/s. a) To read switch status if switch is on, turn on LED or if switch is off, turn off LED. b) To blink the LED with different delay.
2. To interface seven segment LED display and program to implement countdown/up decimal digit 9-0
3. LCD (2X16) interfacing.
4. Interfacing of stepper motor and rotating stepper motor by N steps clockwise / anticlockwise with speed control.
5. Generate square, saw tooth, triangular and staircase waveform using DAC interface. 6. Display of 4-digit decimal number using the multiplexed 7-segment display interface.
7. Analog to digital conversion using internal ADC and display the result on LCD (using Internal ADC in PIC18F458).
8. Interfacing of serial ADC (MCP320x).
9. Speed control of DC motor using PWM (pulse delay to be implemented using timers).
10. To stop/start toggling of LED, when there is an external interrupt.
11. Interfacing of matrix keyboard (4X4).
12. Serial communication between microcontroller and PC.
13. Interfacing of Real Time Clock (DS1307).
14. Interfacing of I2C based EEPROM/RAM/Flash

(Any five experiments from each group)

Paper 6 : Programming with PIC Microcontroller

Credits : 3 No. of Hours/ week : 4
Contents: 56 Hrs SE Marks : 80 IA Marks: 20

Unit 1 10 Hrs

Introduction to Microprocessors and Microcontrollers, Microprocessor Architecture: Harvard and Van-Neumann Architecture, CISC and RISC processors and their architectures. Difference between microprocessor and microcontroller. Introduction to Embedded Systems, Examples of Embedded Systems, Design Parameters of Embedded Systems, Embedded Software Development Tools: Integrated Development Environment(IDE). Editor, Assemblers, Compilers, linker, loader, Instruction Set Simulator(ISS) Debugging Tools and Techniques, Emulators.
8051 Microcontroller: Architecture, Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

Unit 2 14 Hrs

Addressing Modes, Instruction set. Simple Assembly language program examples to use the instructions of 8051. Stack and Subroutine instructions. Assembly language Illustrative programs. Timer/counter, serial communication, interrupts and interfacing of 8051.

Unit 3 16 Hrs

PIC18 Microcontrollers: Overview of the PIC microcontroller family, Architecture and features of 18F458, Memory organization, Data memory organization, EEPROM, flash memory, Special Function Registers, Program Counter, Configuration registers, Stack memory, Interrupts, I/O ports, Timers, USART, Capture/Compare/PWM (CCP) Modules, MSSP Serial Port, CAN module, ADC, Special features of the CPU, Oscillator sources. Clock source switching, Instruction set. Watchdog Timer.

Unit 4 20 Hrs

Hardware interfacing and Microcontroller Programming in C: Data types and time delays, Data Serialization in C, Introduction to Communication Protocols – RS 232, I2C, USB, USART, SPI, CAN, and IrDA.
Program ROM allocation, Data RAM allocation, I/O Programming, Timer Programming, Automatic Stack operations, Programmer access to the Stack, serial port programming, interrupt programming, generation of PWM signal PWM Motor Control with CCP.
Interfacing to 8051 and PIC: Switch, LED, seven segment LED, Keyboard, LCD, External ADC, DAC interfacing, Stepper motor, DC motor interfacing, Real time clock (RTC) and serial ADC.
Erasing and Writing Flash & EEPROM Memories For Data Storage. Sensor Interfacing and Signal Conditioning Standard.

Reference Books

1. Muhammad Tahir and Kashif Javed, “ARM Microprocessor Systems: Cortex-M Architecture, Programming, and Interfacing,” 1st Edition, CRC Press, 2017.
2. Kenneth J. Ayala, “The 8051 Microcontroller”, 3rd Edition, Thomson /Cengage Learning,1997

3. Muhammad Ali Mazidi and Janice Gillespie and Rollin D, "The 8051 Microcontroller and Embedded Systems using assembly and C,"1st Edition, Pearson, 2006.
4. Tim Wilmshurst, "Designing Embedded Systems with PIC Microcontrollers: Principles and applications", First Edition, Elsevier, 2007.
5. Muhammad Ali Mazidi and Rolin D, Mckinlay, "PIC Microcontroller and Embedded Systems using assembly and C for PIC18," 1stEdition, Pearson, 2008.
6. John Pitman, "Design with PIC Microcontrollers," 1st Edition, Prentice Hall, 1997.

Compulsory Practical Paper 2

Programs on interfacing sensors with Arduino

1. Temperature Sensor (LM35 or DHT11)
2. Interfacing LDR and LED
3. Interfacing Ultrasonic sensor(HC-SR04) as input to switch on LED at the output
4. Interfacing PIR sensor
5. Interfacing Gas Sensor (MQ-2/MQ-135)
6. Interfacing Heartbeat Sensor (Pulse Sensor or IR-type)
7. Interfacing Soil Moisture Sensor
8. Interfacing IR Sesor for Object detection
9. Interfacing LCD (Scrolling Text)
10. Interfacing DH11 and display the temperature in the LCD
11. Interfacing Flame sensor for fire alarm
12. Interfacing Rain sensor
13. Interfacing Clap switch and switch on LED
14. Interfacing tilt sensor
15. Interfacing Color Sensor (TCS3200)
16. Interfacing RTC Module (DS3231)
17. Interfacing Touch sensor (TTP223)
18. Interfacing Temperature & Pressure sensor (BMP180)

SIXTH SEMESTER

Course Title: Microwave Devices & Artificial Intelligence	Course Credits: 3
Total Contact Hours: 56Hrs	Duration of ESA: 4 Hrs
Formative Assessment Marks: 20 marks	Summative Assessment Marks: 80 marks

Course Outcomes (COs):

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

C**O1:** Explain the fundamentals of microwave engineering, transmission lines, propagation, and passive microwave components used in communication systems.

CO2: Analyze the construction, operating principles, characteristics, and applications of microwave tubes and semiconductor devices.

CO3: Evaluate microwave antennas and modern microwave applications including radar, satellite communication, RF front-end systems, biomedical imaging, remote sensing, and 5G communication.

CO4: Describe the concepts of Artificial Intelligence, Machine Learning, Deep Learning, Edge AI, TinyML, and their applications in electronics and embedded systems.

CO5: Apply machine learning concepts, feature extraction, data preprocessing techniques, and AI-enabled IoT solutions using the ESP32 architecture.

CO6: Apply Python programming, data analysis, visualization, machine learning libraries, and ESP32 programming to develop intelligent IoT and embedded AI applications.

Course Outcomes Mapped to Units

Unit	Course Outcome
Unit 1	**CO1:** Explain microwave fundamentals, transmission lines, passive components, and microwave tubes used in microwave communication systems.
Unit 2	**CO2:** Analyze microwave semiconductor devices, antennas, and their applications in modern microwave communication systems.
Unit 2	**CO3:** Evaluate microwave technologies employed in radar, satellite communication, RF front-end systems, biomedical applications, remote sensing, and 5G communication.
Unit 3	**CO4:** Describe AI, Machine Learning, Deep Learning, Edge AI, TinyML, and their applications in electronics and embedded systems.
Unit 3	**CO5:** Apply fundamental machine learning concepts, data preprocessing techniques, and AI-enabled IoT solutions using ESP32 architecture.

Paper 7: Microwave Devices & Artificial Intelligence 56 Hrs

Content

Unit-1 14 Hrs

Introduction to Microwaves: Limitations of Conventional Devices at Microwave frequency, Microwave frequency spectrum, Applications of microwave, Advantages and limitations of microwave frequencies, Microwave propagation concepts, Microwave communication systems.

Microwave Transmission Lines: Simple study of Waveguides, Rectangular and circular waveguides, Modes of propagation (TE modes, TM modes and TEM modes, Cut-off frequency, Micro strip lines, Coplanar waveguide, slot lines.

Microwave Passive Components: Directional couplers, Tee junctions, Magic tee, Hybrid couplers, Circulators, Isolators, Attenuators and Resonators.

Microwave Tubes: Construction, Principle of operation, Characteristics and Applications of Two-cavity klystron, Reflex klystron, Magnetron and Traveling Wave Tube (TWT).

Unit-2 14 Hrs

Microwave Semiconductor Devices: Working principle, V-I characteristics, and Microwave applications of Gunn diode, IMPATT diode, BARITT diode, PIN diode, Schottky diode.

Microwave Antennas Horn antenna, Parabolic reflector antenna, Slot antenna and Microstrip antenna.

Modern Microwave Applications: Radar systems, Satellite communication, RF front-end systems, Wireless and mobile communication, Microwave imaging, Biomedical microwave applications, Remote sensing, Millimeter-wave communication and 5G and beyond

Unit3: 14 Hrs

Fundamentals of Artificial Intelligence: Introduction, Ethical aspects of Artificial Intelligence, Comparison between AI, ML and Deep Learning, AI applications in Electronics , Introduction to Edge AI, Introduction to TinyML , Introduction to Machine Learning , Types of Machine Learning , Supervised Learning , Unsupervised Learning , Reinforcement Learning , Training and testing datasets , Feature extraction and preprocessing, AI in IoT and Embedded Systems , Overview of ESP32 architecture.

Unit 4: 14 hrs

Introduction to Python , Data types, loops, functions , NumPy basics , Pandas for data handling ,Data visualization using Matplotlib, Machine Learning libraries, ESP32 setup using ArduinoIDE , LED control using ESP32 , Wi-Fi communication using ESP32 , Sensor interfacing (DHT11 / ultrasonic sensor) with ESP32.

Textbooks

1. Microwave Engineering by David M. Pozar, 5th edition (2021), Wiley.
2. Microwave Devices and Circuits by Samuel Y. Liao, 3rd edition, Prentice-Hall / Pearson Education.
3. Foundations for Microwave Engineering by Robert E. Collin, 2nd edition, Wiley
4. Microwave Engineering by G.S.N. Raju, 1st edition, I.K. International, New Delhi
5. Microwave Devices-K C Gupta

Course Title: IoT Lab	Course Credits: 2
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 10 marks	Summative AssessmentMarks: 40 marks

Course Outcomes (COs):

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

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research.
2. To acquire experimental skills, analysing the results and interpret data.
3. Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.
4. Capacity to identify and implementation of the formulae to solve the electronic related issues and analyse the problems in various sub disciplines of electronics.
5. Capability to use the Modern Tools / Techniques.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with ProgramOutcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	**1**	**2**	**3**	**4**	**5**	**6**
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research						
To acquire experimental skills, analysing the results and interpret data.	**x**					
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.	**x**					
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.						
Capability to use the Modern Tools / Techniques.	**x**					

(IOT- Lab)

1. Starting Raspbian OS, Familiarization with Raspberry Pi components and interface, Connecting to Ethernet, Monitor, USB.
2. Displaying different LED patterns with Raspberry Pi.
3. Displaying Time over 4-Digit 7-Segment display using Raspberry Pi.
4. Raspberry Pi based Oscilloscope.
5. Controlling Raspberry Pi with WhatsApp.
6. Setting up wireless Access point using Raspberry Pi.
7. Fingerprint Sensor interfacing with Raspberry Pi.
8. Raspberry Pi GPS module interfacing.
9. IoT based Web Controlled Home Automation using Raspberry Pi.
10. Visitor Monitoring with Raspberry Pi and Pi Camera.

IoT programs

1. To interface LED/Buzzer with Raspberry Pi and write a program to 'turn ON' LED for 1 sec after every 2 seconds.
2. To interface the Push button/Digital sensor (IR/LDR) Raspberry Pi and write a program to 'turn ON' LED when a push button is pressed or at sensor detection.
3. To interface the DHT11 sensor with Raspberry Pi and write a program to print temperature and humidity readings.
4. To interface OLED with Raspberry Pi and write a program to print its temperature and humidity readings.
5. To interface the motor using a relay with Raspberry Pi and write a program to 'turn ON' the motor when a push button is pressed.
6. Write an Raspberry Pi program to interface the Soil Moisture Sensor.
7. Write an Raspberry Pi program to interface the LDR/Photo Sensor.
8. Write a program to interface an Ultrasonic Sensor with Raspberry Pi.

PAPER 8: Internet of Things and Robotics

Credits : 3 No. of Hours/ week : 4
Contents: 56 Hrs SE Marks : 80 IA Marks: 20

Unit 1 15 Hrs

Definition and evolution of the Internet of Things. IoT architecture and components. IoT communication protocols: MQTT, CoAP, HTTP. IoT application domains and use cases. Overview of IoT devices: microcontrollers, sensors, actuators. Types and characteristics of sensors used in IoT applications. Interfacing sensors with microcontrollers. Data acquisition and sensor fusion techniques.

Unit 2 15 Hrs

Wireless communication technologies for IoT: Wi-Fi, Bluetooth, Zigbee, LoRaWAN, NodeMCU and ESP 32 modules - Overview of these modules.
IoT network topologies: star, mesh, and hybrid networks. IoT data management and storage. IoT protocols for device-to-device and device-to-cloud communication. IoT application development platforms and frameworks. Design and implementation of IoT applications. IoT security challenges and solutions. Privacy and ethical considerations in IoT.

Unit 3 15 Hrs

Definitions of Robots, Robotics, Motivation, A Brief History of Robotics, A Robot System, Interdisciplinary Areas in Robots, Classification of Robots, Introduction to embedded system, Understanding Embedded System, Sensors, Classification of sensors(contact & non contact), characteristics of sensors, Touch sensor, Position sensor, optical sensor, IR, PIR, Ultrasonic, temperature, displacement sensor.

Unit 4 15 Hrs

Getting Started with Programming platform of Robots: Installation of IDE, Pin configuration and architecture of Microcontroller (Atmel series/Arduino), Device and platform features. Concept of digital and analog ports. Familiarizing with Interfacing Board, Introduction to Embedded C platform, Review of Basic Concepts, Arduino data types, Variables and constants, Operators, Control Statements, Arrays Functions, I/o Functions, Pins Configured as INPUT, Pins Configured as OUTPUT, Incorporating time delay() function, delay Microseconds() function, millis() function, micros() function.

Reference Books Robotics

1. Fundamentals of Robotics by D K Pratihar
2. Robotics Simplified: An Illustrative Guide to Learn Fundamentals of Robotics, by Dr. Jisu Elsa Jacob , Manjunath N
3. Introduction to Robotics | Fourth Edition by John Craig
4. Arduino Robotics by John-David Warren (Author), Josh Adamsduino
5. Programming in 24 Hours by Richard Blum
6. Getting Started with Arduino: The Open Source Electronics Prototyping Platform Book by Massimo Banzi and Michael Shiloh
7. Robotics for Engineers –Yoram Koren, McGraw Hill International, 1st edition, 1985. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009
8. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk

Reference Books IOT

1 Internet of Things: Principles and Paradigms by Rajkumar Buyya, Amir,VahidDastjerdi, and Anton Y. Dongarra.

2 Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry by MaciejKranz.

3 IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, and Robert Barton.

4 Internet of Things with Arduino Cookbook" by Marco Schwartz

5 Arduino Home Automation Projects" by Marco Schwartz and Oliver Manickum

6 Weste, Neil H. E.; Harris, David; Banerjee, Ayan, " CMOS VLSI Design: A Circuits and System Perspective," 3rd Edition, Pearson Education

7 Douglas A. Pucknell and Kamran Eshraghian, "BASIC VLSI DESIGN," 3rd ed.

8 John P. Uyemura, "Introduction to VLSI Circuits and Systems,".

9 Katsuhiko Ogata, Modern Control Engineering, Prentice Hall.

10 Benjamin C. Kuo, Automatic Control Systems, Prentice Hall.

Compulsory Lab: **Project**

Credits : 2 No. of Hours/ week : 3

Contents: 45 Hrs SE Marks : 40 IA Marks: 10