Government of Karnataka

Department of Collegiate and Technical Education

Board of Technical Examinations, Bangalore

Course Code	20EC21P	**Semester**	II
Course Title	**Electronics Components and Devices (ECD)**	**Course Group**	Core
No. of Credits	4	**Type of Course**	Lecturing & Practice
Course Category	EC	**Total Contact Hours**	6Hrs Per Week 78Hrs Per Semester
Prerequisites	Arithmetic, basic of electronics	**Teaching Scheme**	(L: T:P) = 1:0:2
CIE Marks	60	**SEE Marks**	40

RATIONALE

An electronic circuit is a structure that directs and controls electric current to perform various functions including signal amplification, computation, and data transfer. It comprises several semiconductor devices & components such as resistors, transistors, capacitors, inductors, and diodes. These Semiconductor devices supply themselves in integrating into complex and are readily manufacturable into microelectronic circuits. They also find a good scope in the future in forming key components for the majority of electrical and electronic instruments and systems in various fields such as communications, data-processing, consumer electronics & robots and also in industrial control equipment.

COURSE SKILL SET

The goal of the course is to help the student to attain the following industry-need competencies through various teaching-learning processes.

- Identifying various components and semiconductor devices used in industrial applications.
- Interpretation of datasheets and usage of instruments.
- Basic knowledge of components, devices and simple applications.
- Perform soldering job, build and test analog electronic circuits for simple applications.
- Testing and experimentation under simulated and real environments.

INSTRUCTIONAL STRATEGY

1. This is theory-practice course with 1:2 time-share. Normally, the Lecturer is expected essentially to teach the relevant theoretical parts in one hour prior to the 2-hour lab session so that at the end the class the student attains the specified class-outcome. This requires well planning from Lecturer side to adhere to the schedules.
2. The Lecturer is expected to emphasize only the essential concepts/components/circuit/topics in respect of the practicing experiment in one-hour.
3. Normally in industrial environments, experiments are conducted under simulated environments before real-environment experimentation owing to the benefits of simulation. Same procedure is adapted here too with a few exceptions.
4. Awareness and safety-precautions on use of instruments/laboratory resources is mandatory for all students prior to the experimentation.
5. Lecturers shall advise repetition of experiments wherever possible and necessary.
6. Pre-reading of the content and experiment-procedure will have a greater impact on effectiveness and taking forward of this course and hence students shall be advised to do so.
7. The intent of the activity is to integrate multiple concepts learnt in the course and to create interest in students to face the integrating-challenge; hence, the Lecturer is advised to assign only such the activities.
8. Activity project need not be designed by student, teacher may provide or guide to search; however, it has to be simulated, fabricated and tested by the students.

LEVELS OF COURSE SKILL – SETS

Sl. No.	LEVEL	SKILL SET/S To be Attained
1	Level-1	Identification of components and semiconductor devices. Testing electronics components and semiconductor devices. Adaption of the best soldering methods/practices for fabrication of circuits.
2	Level-2	Experimenting to observe characteristics/behaviour/working of semiconductor devices.

		Building simple application development using components and semiconductor devices.
3	**Level-3**	Application, circuit simulation, testing and implementation.

COURSE OUT COMES

On successful completion of the course, the students will be able to

CO1	Identify and select the electronic components and devices and instruments.
CO2	Test electronic components and devices.
CO3	Fabricate/construct discrete circuits.
CO4	Select and analyse electronic circuits for characteristics and/or simple applications.
CO5	Experiment the circuit characteristics/simple applications under simulated and real environment.

Course Outcomes CO, PO, Cognitive-level and Teaching hours map

Course Outcomes	CL	Linked PO
CO1: Identify and select the electronic components and devices and instruments.	U/A	1,2,4,5
CO2: Test electronic components and devices.	U/A	1,4,5
CO3: Fabricate/construct discrete circuits.	U/A	1,4,5
CO4: Select and analyse electronic circuits for characteristics and/or simple applications.	U/A	1,3,4,5
CO5: Experiment the circuit characteristics/simple applications under simulated and real environment.	U/A	1,3,4,5,7

COURSE CONTENTS

The following topics/subtopics is to be taught and assessed in order to develop Unit Skill sets for achieving CO to attain identified skill sets

Sl. No	Content	Experiment	Method/ Class Outcome	L: T:P
UNIT 01: BASICS OF ELECTRONIC COMPONENTS				
Note: Demonstrations are hand-on and can be supported by videos/animation wherever possible to see that the students understand the concepts. Real experimentation is after simulation.				
1	Passive components (Resistor, Inductors and capacitors): Introduction, role, symbols, units, types/classification, identification, selection and applications.	Identification and finding/assessing values/tolerances (using color codes, labels) of passive components of different packages.	Demonstration, examples and exercises. **Identify and ascertain roles and values of components.**	**1:0:2**
2	Usage of electronic instruments: Multi-meter and LCR meter.	Verification of the values of passive components using multimeter and LCR meters (for the same components used in Expt.1)	Demonstration and exercises. **Use meters to assess values and to test components.**	**1:0:2**
3	Active components(Diode, Zener Diode, BJT): Introduction, list, role/function, symbols, types/packages, and applications	Identification of the active components, terminals, packages, and testing them for working, using multimeter.	Demonstration and exercises. **Identify terminals, packages and test the active components.**	**1:0:2**
4	Active components (MOSFET, SCR, DIAC, TRIAC): Role/function symbols, types and applications.	Identification of the active components, terminals, packages, and testing them for working, using multimeter.	Demonstration and experiment **Identify terminals, packages and test the active components.**	**1:0:2**

5	Packing, Stocking, Handling of components and their electrostatic safety. Understand the data/ specification sheets of all components Selection criterion of components. Soldering types and precautions.	Preparation of components, use of soldering iron and lead and flux. Standard Soldering practice to connect the components on base-board /PCB/assembly board (follow soldering standard).	Videos, demonstration and exercises. **Identify specifications from component data-sheets and perform standard soldering.**	**1:0:2**
6	Atomic structure and energy-band diagram of conductors, insulators and semiconductors- comparison and examples.	Soldering practice (continued) and de-soldering.	Videos, demonstration and exercises. **Compare the features of conductors, insulators and semiconductors**. **Solder and de-solder the components on PCBs/Baseboards.**	**1:0:2**
7	Simulators: Concept, advantages and features. Prominent simulation softwares and their features.	Using simulator/editors: Identification, selection and use of sources, components, devices and instruments. Component specifications and properties, schematic preparation. Component foot-print/3D views.	Demonstration. **Use simulator for experimentation.**	**1:0:2**
8	Semiconductor- Covalent bond, intrinsic and extrinsic SC: N type & P type, PN junction, biasing, current conduction, effect of temperature, and diode.	Usage of electronic Equipments: power supply, CRO and signal generator. Both in real and simulated environment.	Videos, demonstration and exercises. **Understand the current conduction in PN**	**1:0:2**

			junction. Use CROs, RPS and Sig. generators.	
UNIT 02: BASICS OF SEMICONDUCTOR DEVICES				
9	PN Junction Diode: Formation of PN junction. Potential barrier. Depletion region. Forward and Reverse biasing of diode and VI characteristics. Diode ratings and parameters.	Plot VI characteristics of Diode and ascertain Ri and cut-in voltage using simulator.	Animation/Video/ Visuals to show the working of PN junction/ diode. Experiment, graph and calculations. **Know the behavior of PN junction for biasing voltages.**	**1:0:2**
10	Zener diode: Working principle, constructional features, Avalanche and Zener breakdown. Reverse VI characteristics and applications.	Plot reverse VI characteristics of Zener ascertain Zener voltage using simulator.	Animation/Video/ Visuals to show the working of Zener Diode. Experiment and graph. **Know the behavior of Zener diode for reverse biasing.**	
11	Simple problems on diode circuits/selection of different biasing voltages to illustrate FB and RB of diode.	VI characteristics of diode (expt. 9) in real environment. Plot reverse VI characteristics of Zener diode (expt.10) in real environment.	Experiment and comparison with simulated results. **Compare real and simulated results.**	
12	AC-to-DC conversion: Need, rectification, half-wave and full-wave rectification. Half-wave rectifier: waveform, efficiency and ripple factor.	Experiment to obtain half-wave rectification under simulated environment: Obtain waveform, ripple factor, efficiency and PIV.	Experiment, waveforms and calculations. **Apply diode-switch to convert AC to DC.**	

13	Bridge Rectifier: efficiency and its ripple factor. Filter components and their role in reducing ripple.	Experiment to obtain full-wave rectification (using bridge) and filtering under simulated environment: Obtain waveform, ripple factor, efficiency and PIV, without and Full wave rectifier with C-filter	Experiment, waveform and calculations. **Apply diode-switches and filter to convert AC to DC more efficiently.**	**1:0:2**
14	Simple problems on half-wave, full-wave rectifier and filter circuits.	Conduct Expt. 13 under real environment.	Experiment, graph/waveforms and calculations. **Compare simulated and real-experiment results.**	**1:0:2**
15	Voltage regulation: Concept, need, Zener diode as voltage regulator. Voltage regulator circuit working. Condition and types of regulation.	Show how Zener diode can be used as voltage regulator in simulated and real environments.	Experiment and interpretation of result. **Use of Zener diode for regulated voltage supply.**	**1:0:2**
16	BJT: Types, construction, symbols, functions of base, emitter and collector, Current gain in CE mode.	Obtain output characteristics of BJT in CE configuration under simulated environment. Calculate input resistance, and mark the different regions on output characteristics and calculate current gain.	Experiment, graph and calculations **Understand the** **behaviour of BJT**	**1:0:2**
17	BJT: Modes of operation-comparison.BJT packages and specifications. Data sheet interpretation.	Experiments 16 under real environment.	Experiment, graph and calculations. **Compare with simulated results.**	

18	Operating regions of BJT, BJT as a switch and amplifier. Thermal runaway and need for heat sink.	Experiment BJT as a switch under simulation environment. (This is linked to experiment 21)	Experiment **Use BJT as a current-controlled electronic switch**	**1:0:2**
19	MOSFET: Field effect, types, construction, working and applications. MOSFET applications. MOSFET as switch. Comparison of BJT and MOSFET.	Show how MOSFET can be used as a switch under simulated environment. (This is linked to experiment 21)	Experiment **Use MOSFET as a voltage-controlled switch**	**1:0:2**
20	SCR: Construction, Working, Operating modes, definition of triggering and commutation.	Forward VI characteristics of SCR simulation and real environment.	Experiment **Understand the behavior of controlled switch**	**1:0:2**
UNIT 03: OPTO ELECTRONIC DEVICES				
21	Opto-electronic devices: Introduction, principle of photo emission, photoconduction and photovoltaic effects. LED: Construction features, role, biasing, packages, and ratings.	Switching to blink an LED using BJT or MOSFET. Experiment under simulated and real environment. This is extension of Expt. 18 and 19)	Experiment. **Use electronic switch and LED in application development.**	**1:0:2**
22	LDR: Construction features, role, package, specifications, and application. Explanation of automatic street-light control circuit.	Conduct a simple experiment to automatically control street-light using LDR and SCR in simulated environment.	Experiment. **Use electronic components and devices to solve simple real-world problem**	**1:0:2**

23	Photodiode and Phototransistor: Construction features, role, specifications, packages, and applications.	Conduct experiment 22 in real environment.	Experiment. **Compare real and simulated results.**	**1:0:2**
UNIT 04: SENSORS AND ACTUATORS				
24	Sensors: Principle and classification. List passive sensors, their working principle/role, packages, specifications, and applications. Anyone passive-sensor-based simple application in detail.	Experiment any passive-sensor-based simple application to under simulated environments to illustrate use of sensor for solving simple real-world problem.	Experiment. **Use electronic components and/or devices (sensor) to solve simple real-world problem**	**1:0:2**
25	Active sensors: List active sensors, their working principle/role, packages, specifications, and applications. Anyone active-sensor-based simple application in detail.	Experiment 24 under real environment	Experiment, **Use electronic components and/or devices (sensors) to solve simple real-world problem**	**1:0:2**
26	Actuators: Basic principle/role and types/classification. Roles/applications of different actuators. Simple application involving actuator in detail.	Conduct a simple application involving actuator under simulated and/or real environment.	Experiment, **Use electronic components and/or devices (actuator) to solve simple real-world problem**	**1:0:2**

Mapping of COs, POs, Cognitive-levels and Teaching Hours

CO	Course Outcome	PO Mapping	Experiential	Cognitive	Lecture	Tutorial &	TOTA

CO1	Identify and select the electronic components and devices and instruments	1,2,4, 5	**U1**	U/A	8	16	24
CO2	Test electronic components and devices.	1,4,5					
CO3	Fabricate/construct discrete circuits.	1,4,5	**U2, U3 & U4**	**U/A**	18	36	54
CO4	Select and analyse electronic circuits for characteristics and/or simple applications.	1,3,4, 5					
CO5	Experiment the circuit characteristics/simple applications under simulated and real environment.	1,3,4, 5,7					
					26	**52**	**78**

Course	**COs**	**Program Outcomes (POs)**						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Electronic Components and Devices	CO1	3	1	0	2	1	0	0
	CO2	3	0	0	2	1	0	0
	CO3	3	0	0	2	1	0	0
	CO4	3	0	1	2	1	0	0
	CO5	3	0	1	2	1	0	2
Legends: Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped								

SUGGESTED LEARNING RESOURCES

Reference Books:

6. Principles of Electronics, Rohit Mehta & V K Mehta, S. Chand Publishing ISBN: 9788121924504
7. Fundamentals of Electrical and Electronics Engineering, B. L. Theraja, S. Chand and Company. REPRINT 2013, ISBN 8121926602
8. Electronic Components, Dr. K. Padmanabhan and P. Swaminathan, Lakshmi Publications, 2006.
9. Electronic Devices and Circuits, David A. Bell, Oxford University Press, ISBN: 9780195693409

10. Sensors Handbook-SabrieSoloman-McGraw Hill publication, Second Edition.
11. Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden, Springer Publications, Third Edition.

E-Resources

1. http://www.electronics-tutorials.ws
2. http://electrical4u.com/

Student Activities (CIE 20 marks)

Introduction

Group of 4(maximum) students should conduct **UNIQUE** activity. Suggestive activities are as follow, but not limited to these only, any similar activity can be assigned. Each activity can be carried out off-class hours in the laboratory. Choose the activity for which circuits, boards and components are easily available with the guidance of the teacher, and the activity shall have the scope to integrate multiple concepts. Students are advised plan and start the activity in 7th week and complete it by 11th week.

a. Example activities

SL. No.	Activities
1.	Fire detector application.
2.	Intruder detector
3.	LED serial-sets
4.	Clapp/sound detector application
5.	Smoke detector application
6.	LED bulb
7.	And all such simple circuits/projects that have scope to integrate multiple concepts learnt and for which circuits/boards/components are easily available.

10.3 Execution details

1.Maximum of 4 students in each batch.

2. Write qualitative report not exceeding 8 pages; one report per batch.
3. Each of the activity can be carried off-class, and shall be presented to the teacher using suitable presentation mode

4. Assessment shall be made based on information collection, integration of concepts involved, execution (simulation/fabrication/testing/results), report, presentation, and role in the team.

10.4 Activity Assessment Scheme

Sl. No.	Parameter to be Observed for Activity Assessment	Marks Allotted
1	Information collection	4
2	Level of integration of concepts/creativity	4
3	Simulation, testing and result	4
4	Fabrication, testing and result	4
5	Report Presentation Role in the team	4
	Total	**20**

COURSE ASSESSMENT AND EVALUATION CHART

Sl.No	Assessment	Duration	Max marks	Conversion
1.	CIE Assessment 1 (Written Test -1-theory) - At the end of **3rd week**	60 minutes	20	Average of two written tests 20
2.	CIE Assessment 2 (Written Test -2-theory) - At the end of **13th week**	60 minutes	20	
3.	CIE Assessment 3 (Skill test) - At the end of **5th week**	3 Hours	20	Average of three skill tests 20
4	CIE Assessment 4 (Skill test) - At the end of **7th week**	3 Hours	20	
5	CIE Assessment 5 (Skill test) - At the end of **9th week**	3 Hours	20	
6	CIE Assessment 6 (Student activity) - At the end of **11th week**	-	20	20
7.	**Total Continuous Internal Evaluation (CIE) Assessment**			**60**

8.	**Semester End Examination (SEE) Assessment** **(Practical Test)**	**3 Hours**	**100**	**40**
Marks			**Total**	**100**

Note:

1. CIE written test is conducted for 20 marks (Two sections). Each section shall have two full questions of same CL, CO. Student shall answer one full question (10 marks) from each section.
2. CIE Skill test is conducted for 100 marks (3 Hours duration) as per scheme of evaluation and the obtained marks are scaled down to 20 marks

Scheme of Evaluation for CIE and SEE (Skill test)

(CONTINOUS INTERNAL EVALUATION & SEMESTER END EXAMINATION)

Sl. No.	Particulars	Marks
1	Understanding of the problem, identification and selection of components/devices/equipment, inputs and expected outputs.	10
2	Experimentation/Execution under simulated environment	20
3	Circuit building using soldering and board (Assessment indicators: correctness, quality, effective use of space and soldering in conformance with standards)	20
4	Experimentation and recording the observed readings in real environment	30
5	Results interpretation (Calculation/accuracy/graph/table)	10
6	Viva-voice	10
Total		**100**

NOTE:

- Both CIE &SEE is conducted for 100 marks (3 Hrsduration).
- Examiner is suggested to assign the question randomly and uniformly so as to avoid resource shortage in the laboratory.
- Reasonable opportunities shall be given to the student to write the circuit. Until and unless correct circuit is written he should not be allowed to rig-up/fabricate the circuit; however, student can be allowed to work under simulation environment. Then he can rig-up/fabricate the circuit for real execution.
- Normally, the experiment is simulated first, then moving on to real experimentation.

However, order of simulation and real experimentation can be interchanged in theexamination for the purpose of resource and time management during the examination.

RUBRICS FOR ACTIVITY

RUBRICS FOR ACTIVITY (Example only) Faculty need to develop appropriate rubrics for respective activity						
Dimension	**Beginning**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	8
Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	6
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	8
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	8
					Average / Total Marks:(8+6+8+8)/4	**7.5=8**

Model Question Paper FOR CIE (WRITTEN TEST)

Programme:	**Semester: II**
Course Name :	**Max Marks :20**
CourseCode :	**Duration: 60minutes**
Name of thecoursecoordinator:	**Test: I/II**

Note: Answer one full question from each section. One full question carries 10 marks.

Qn. No	Question	CL	CO	PO	Marks
	Section-1				
1.a)					
b)					
c)					
2.a)					
b)					
c)					
	Section-2				
3.a)					
b)					
c)					
4.a)					
b)					
c)					
	Section-3				
5.a)					
b)					
c)					
6.a)					
b)					
c)					

Equipment List (For a batch of 20 students)

Sl. No.	NAME OF THE EQUIPMENT	Quantity
01	Dual Channel 0-30V at 2/1A RPS with short-circuit protection	10
02	0-30V at 2/1A RPS with short circuit protection	10
03	Function Generator (0-10MHz)	10
04	Dual Trace Oscilloscope (20MHz)	10
05	Digital multimeters.	20
06	Decade resistance boxes	10
07	Decade capacitance boxes	10
08	Decade inductance boxes	10
09	LCR meter	05

10	Electronic components/Consumables resistors, inductors, capacitors, transformers, hookupwires ,SCR, MOSFET, DIAC,TRIAC, BJT, Photo transistor, Photo diode, JFET, diode, Zener diode, soldering lead etc	10
11	Bread boards, Soldering Gun, Tag Board, 9V battery cells, Bulbs.	10
12	Computer System for Circuit simulation (having Electronics Circuit Simulation Software installed in each computer).	20