Program Name : **Electrical Engineering Program Group**
Program Code : **EE/EP/EU**
Semester : **Second**
Course Title : **Elements of Electronics**
Course Code : **22213**

1. RATIONALE

Diploma engineers have to deal with the various electronic components while maintaining various electrical systems. The study of basic operating principles and handling of various electronics devices will help them to troubleshoot electronics equipment used in electrical system. This course is developed in such a way that, students will be able to apply the knowledge to solve broad electronic engineering application problems in electrical engineering field.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use electronic components and circuits in electrical equipment.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Use relevant diode in different electronics circuits.
b. Use diode in rectifiers and filters.
c. Use BJT and FET in electronics circuits.
d. Use DC regulated power supply.
e. Use Transistor as an oscillator.
f. Use of logic gates in electronics circuits.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
L	T	P			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.
***Legends:* L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.**

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

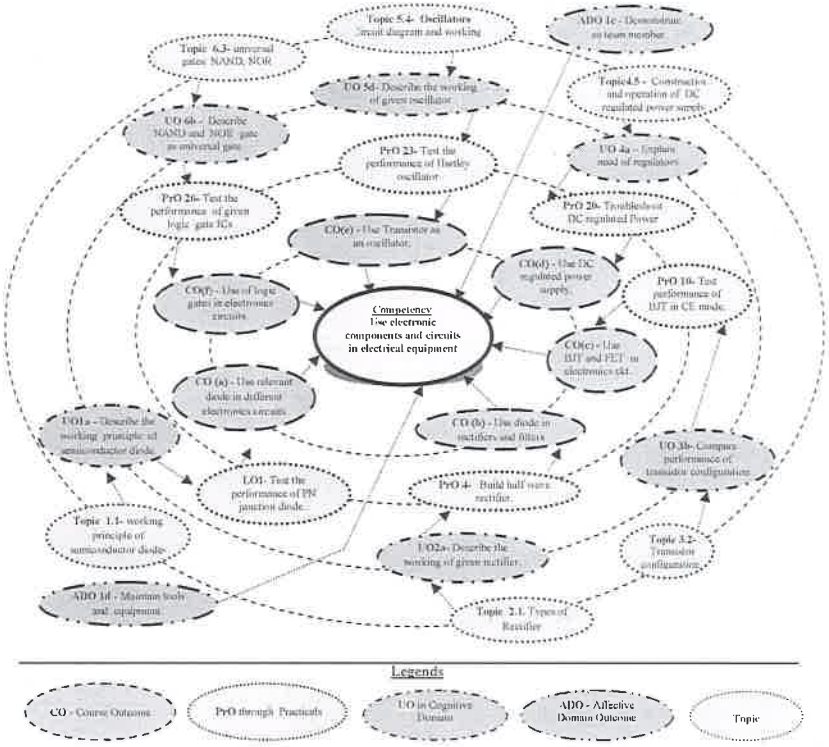

Figure 1 - Course Map

6. SUGGESTED PRACTICALS / EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Test the performance of PN junction diode.	I	02*
2	Test the performance of zener diode	I	02
3	Test the performance of photo diode by varying the light intensity as well as distance.	I	02
4	Build/test half wave rectifier on breadboard.	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
5	Build/ test full wave rectifier on breadboard using two diodes	II	02
6	Build/ test full wave rectifier on breadboard using four diodes	II	02
7	Use LC filter for getting minimum ripple using two diodes.	II	02
8	Use π filter for getting minimum ripple using four diodes.	II	02
9	Identify the terminals of the PNP and NPN.	III	02
10	Build and test zener voltage regulator for the given voltage.	IV	02
11	Test the various blocks of regulated DC power supply.	IV	02
12	Find out faults at different stages of regulated DC power supply.	IV	02
13	Troubleshoot given DC regulated power supply.	IV	02
14	Test the performance of Regulator IC's: IC's 78XX, 79XX.	IV	02
15	Test the performance of IC 723 as Regulator.	IV	02
16	Test the performance of given logic gate ICs.	VI	02
17	Test the performance of given flip flop ICs.	VI	02
		Total	**54**

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs

according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1, 2, 3, 9, 10,11, 12,13,14
2	Cathode Ray Oscilloscope Dual Trace 20Mhz, 1MegaΩ Input Impedance	4,5,6,7,8,9,15
3	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude.	4,5,6,7,8,9
4	Digital Multimeter : 3 1/2 digit display, 9999 counts digital multimeter measures: V_{ac}, V_{dc} (1000V max) , A_{dc}, A_{ac} (10 amp max) , Resistance (0 - 100 MΩ) , Capacitance and Temperature measurement	All
5	Lux meter 3000 Lumen, Battery operated hand held type	3
6	Electronic Work Bench : Bread Board 840 -1000 contact points : Positive and Negative power rails on opposite side of the board , 0-30 V , 2 Amp Variable DC power supply, Function Generator 0-2MHz, CRO 0-30MHz , Digital Multimeter.	All
7	Digital IC Trainer: comprising of 0-30 V, 0-2 A, input/output switches along with LEDs, Bread Board 840 -1000 contact points, built in pulse generator.	16, 17
8	Universal IC Tester: Test a wide range of Digital IC's such as 74 Series, 40/45 Series of CMOS IC's, Test Microprocessors 8085, 8086, Z80 Test Peripherals like 8255, 8279, 8253, 8259, 8251, 8155, 6264,62256,8288,8284.,Auto search facility of IC's,40 pin DIP ZIF sockets provided,28 Touch Key pad with numerical and functional keys 9 Digit Seven Segment Display.	16, 17

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Semiconductor Diode	1a. Describe the construction and working principle of the given diode. 1b. Describe characteristics and application of the given diode. 1c. Describe application of the given opto-coupler. 1d. Compare performance parameters of the given devices.	1.1 Construction, symbol, working principle, specification, applications, forward and reverse biasing and V-I characteristic of following semiconductor diodes: PN junction diode, Zener diode. 1.2 Special diodes : LED, Photodiode, LASER diode and Power diode.
Unit – II Rectifiers and Filters	2a. Describe working of the given rectifier. 2b. Compare the performance of the given rectifiers. 2c. Describe the working of the given type of filter circuit. 2d. Calculate ripple factor, PIV and efficiency of the given type of rectifier. 2e. Justify the selection of rectifier for the given application.	2.1 Types of Rectifiers: Half Wave, Full Wave Rectifier (bridge and center tapped): circuit operation I/O waveforms for voltage and current. 2.2 Parameters of rectifier: Average DC value of current and voltage ripple factor ripple frequency PIV of diode, TUF and efficiency of rectifier. 2.3 Types of Filters: Shunt capacitor, Series inductor, LC and π filter.
Unit– III Transistor	3a. Differentiate the working of the given type of transistors 3b. Compare the performance of the given transistor configurations.	3.1 Different types of transistors: PNP, NPN 3.2 Transistor configurations: CB, CE, CC. 3.3 Transistor as a switch.
Unit– IV Regulators and power supply	4a. Explain concept of the given type of regulation. 4b. Calculate output voltage of the given regulator. 4c. Describe the working of the give type of as variable regulator.	4.1 Load and line regulation. 4.2 Basic Zener diode voltage regulator. 4.3 Regulator IC's: IC's 78XX, 79XX IC 723 as fixed, variable and Dual. Regulated DC power supply. 4.4 Construction and operation of DC Regulated power supply.
Unit– V Oscillators	5a. Explain the given type of feedback 5b. Compare the performance of the given two types of feedback. 5c. Calculate frequency of oscillations for the given data. 5d. Describe working of the given type of oscillator with circuit diagram.	5.1 Types of feedback: Positive feedback, Negative feedback. Barkhausen's criterion 5.2 Oscillator: Circuit Diagram and working of LC, RC and Crystal oscillator.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit–VI Digital Electronics	6a. Convert the given decimal number into binary, octal and hexadecimal number system. 6b. Describe the given gate to work as universal gate. 6c. Build the given logic operations with the given types of gates 6d. Construct the given type of flip flop with sketches.	6.1 Number System: binary, octal decimal and hexadecimal number system. 6.2 Boolean algebra: Demorgans Theorem. 6.3 Logic gates: Logic symbol, logical expression and truth table of AND, OR, NOT EX-OR and EX-NOR gates. 6.4 Universal gates: NAND and NOR. 6.5 Flip flop: Symbol, truth table and working of S R, J K, M S J K, T and D Flip flop.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Semiconductor Diode	06	2	4	2	08
II	Rectifiers and Filters	08	2	4	6	12
III	Transistor	12	3	9	6	18
IV	Regulators and power supply	08	3	4	5	12
V	Oscillators	06	3	4	3	10
VI	Digital Electronics	08	2	4	4	10
Total		**48**	**15**	**29**	**26**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Prepare journals based on practical performed in laboratory.
b. Test different diodes using CRO.
c. Give seminar on any relevant topic.
d. Library survey regarding different data books and manuals.
e. Prepare power point presentation for electronic circuits.
f. Undertake a market survey of different semiconductor components.
g. Trace various electronics components in electrical equipment.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

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a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide students for using data manuals.
f. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Diode**: Build a circuit on general purpose PCB to clip a positive half cycle at 1.5 v of a waveform with input signal 5Vpp., and prepare the report. **(Duration: 8-10 hours)**
b. **Diode:** Build a circuit on general purpose PCB to clamp a waveform at 3.0V using diode and passive components.
c. **Photodiode:** Build a circuit on breadboard to turn the relay on and off by using photo diode and prepare a report.
d. **Rectifier**: Build a half wave rectifier for 6V, 500mA output current on general purpose PCB.
e. **Rectifier**: Build a full wave bridge rectifier with capacitor filter for 6V, 500mA output current on general purpose PCB
f. **Voltage Regulator:** Build a circuit of DC regulated power supply on general purpose PCB for 9V and 500mA output.
g. **Oscillator:** Build circuit to generate audio frequency.
h. **Digital Electronics**: Build LED blinking circuit using suitable digital circuit.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic Devices and Circuit Theory	Boylestead, Robert, Neshelsky, Louis	Pearson Education, New Delhi,2014, ISBN :
2	Electronic Devices and Circuit: An Introduction	Mottershead, Allen	Goodyear Publishing Co. New Delhi, ISBN : 9780876202654

S. No.	Title of Book	Author	Publication
3	The Art of Electronics	Horowitz, Paul Hill, Winfield	Cambridge University Press, New Delhi 2015 ISBN : 9780521689175
4	Fundamental of Electronic Devices and Circuits	Bell, Devid	Oxford University Press New Delhi, 2015, ISBN : 9780195425239
5	Electronic Devices and Circuit	Maini, Anil K.	Wiley India, New Delhi, ISBN : 9788126518951
6	Transistor Selector Handbook	-	Tower's International Foulsham. London (1974), ISBN: 9780572008888

14. SOFTWARE/LEARNING WEBSITES

a. www.nptel.iitm.ac.in
b. www.datasheetcafe.com
c. www.williamson-labs.com
d. www.futurlec.com
e. www.bis.org.in
f. www.learnerstv.com
g. www.cadsoft.io
h. www.khanacademy.