Program Name : **Electronics Engineering, Digital Electronics and Instrumentation Engineering Program Group**

Program Code : **DE/EJ/ET/EN/EX/EQ/IE/IS/IC**

Semester : **Third**

Course Title : **Applied Electronics**

Course Code : **22329**

1. RATIONALE

Enhanced use of electronic gadgets has made electronics engineers to deal with the various types of electronic circuits which generate the required analog/digital output. Transistor has remarkably expanded the utility of electronic equipment. Discrete components are widely used in amplifiers and other electronic systems which the engineering diploma holders (also called as technologist) have to use or maintain. The learning of basic operating principles of electronic circuits will help the students to use the basic electronic equipment. This course is developed in such a way that, students will be able to apply the knowledge of basic electronic circuit working to solve broad based electronic engineering application problems.

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 discrete electronic devices and voltage regulators.**

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 transistor as low Power amplifier.
b. Use BJT as high Power amplifier.
c. Use BJT as feedback amplifier.
d. Use BJT as waveform generator.
e. Maintain IC voltage regulator and SMPS.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	4	8	3	70	28	30*	00	100	40	50#	20	50	20	100	40

(*): 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.

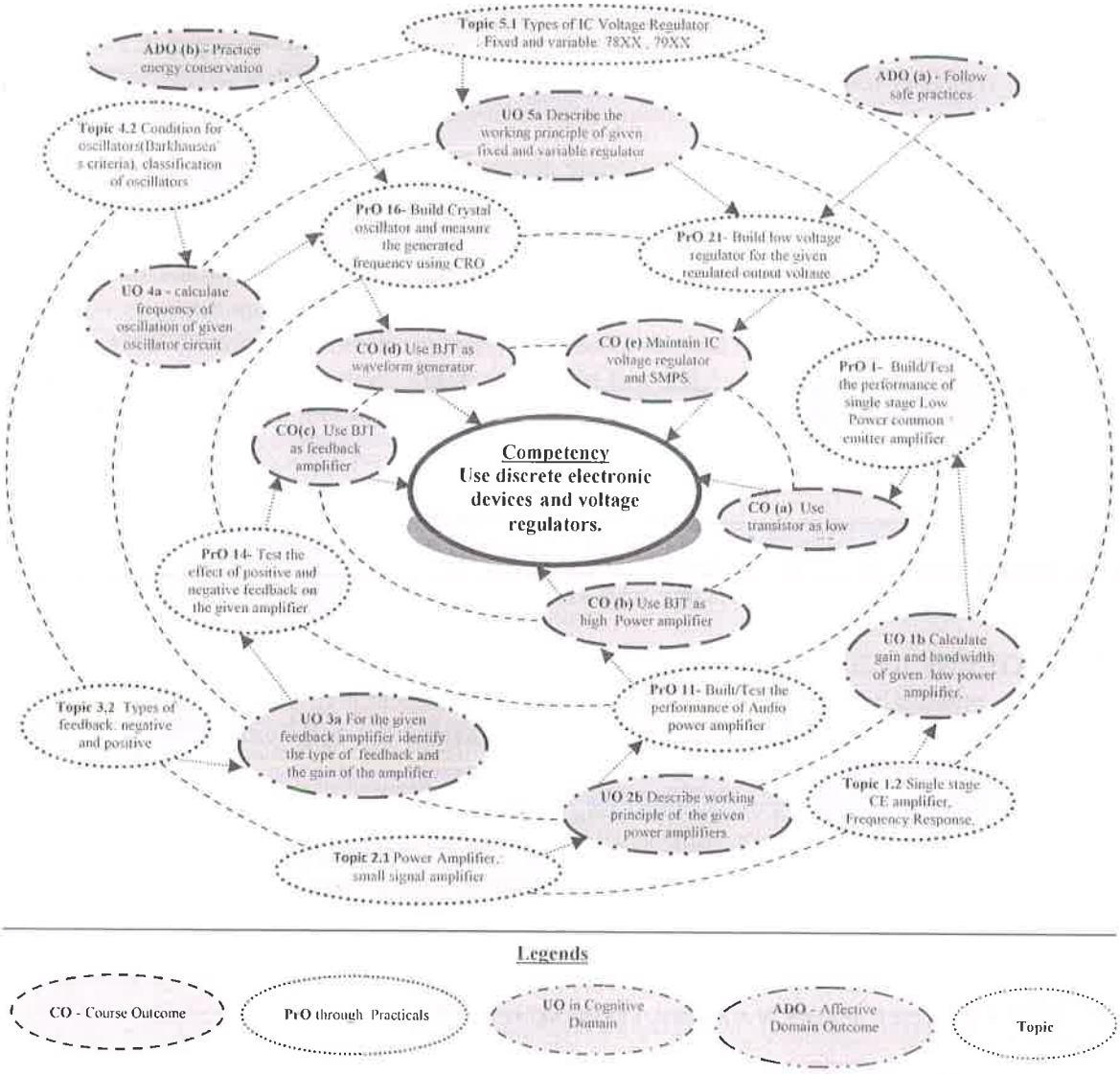

Figure 1 - Course Map

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.

** Use bread board for the following Practials (wherever applicable).*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Build/test the performance of single stage Low Power common emitter amplifier.	I	2*
2	Simulate / test out put Wave form of single stage common	I	2

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	emitter (CE) amplifier using simulation software(like spice, multisim).		
3	Simulate/test the output Wave form of single Stage common source FET amplifier using simulation software	I	2
4	Build/test the performance of single stage Common source FET amplifier.	I	2
5	Build/test the performance of two stage RC Coupled common emitter amplifier using transistor.	I	2*
6	Build/test the performance of two stage direct Coupled amplifier using transistor.	I	2
7	Build/Test the performance of transformer Coupled amplifier.(Part-I)	I	2*
8	Build/Test the performance of transformer Coupled amplifier.(Part-II)	I	2*
9	Build/test the performance of single tuned amplifier using transistor.	I	2
10	Build/test performance of double tuned common Emitter amplifier. (Part-I)	I	2
11	Build/test performance of double tuned common Emitter amplifier. (Part-II)	I	2
12	Build/test performance parameters of single stage class A power amplifier.	II	2
13	Build/test performance parameters of class B Push pull amplifier using transistor.	II	2
14	Build/test the performance of Audio power amplifier.	II	2*
15	Use transistor to build/ test voltage series Feedback amplifier parameters with and without feedback.	III	2
16	Use transistor to built/ test voltage shunt Feedback amplifier parameters with and without feedback.	III	2
17	Test the effect of positive and negative feedback on the given amplifier.(Part-I)	III	2*
18	Test the effect of positive and negative feedback on the given amplifier.(Part-II)	III	2*
19	Build RC phase shift oscillator and measure the generated frequency using CRO.	IV	2
20	Build Crystal oscillator and measure the generated frequency using CRO.	IV	2
21	Simulate Hartley oscillator using any relevant simulation software. (Like spice, multisim, Lab view, LTspice, Octeva).	IV	2*
22	Generate a waveform using Miller's sweep generator and measure sweep time and retrace time.	IV	2
23	Simulate dual voltage regulator using IC78XX and 79XX for the specified regulated output voltage	V	2*
24	Build dual voltage regulator for the specified Regulated output voltage.	V	2
25	Build low voltage regulator using IC723 for the given regulated output voltage. (2V to7V)	V	2*
26	Build high voltage regulator using IC723 for the given regulated output voltage.(7 V to 37 V)	V	2

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
27	Test the performance parameters of voltage regulator using IC LM317.	V	2*
	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 24 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 authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Variable DC power supply 0- 30V, 2A, SC protection	All
2	Dual Power supply 0- 30V, 2A	All
3	Cathode Ray Oscilloscope, Dual Trace 30Mhz and above, 1MegaΩ Input Impedance	1-16
4	Digital storage Oscilloscope, Dual Trace 20Mhz and above, 1MegaΩ Input Impedance	1-16
5	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude	1-12
6	Digital Multimeter: 3and1/2 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 diode ,transistor tester	All
7	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
8	LCR-Q meter, Test frequency standard 100 Hz / 1 kHz; Parameter L-Q, C-D, R-Q and Z-Q,Parameters L 100 Hz, 120 Hz 1 mH - 9999 H 1 KHz 0.1 mH - 999.9 Ht,C 100 Hz, 120Hz 1 pF - 9999 mF Range 1 KHz 0.1 pF - 999.9 mF,Terminals 4 terminals.	All

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Low Power Amplifiers	1a. Explain with sketches the working principle of the given type of amplifier. 1b. Calculate gain and bandwidth of the given low power amplifier. 1c. Compare performance parameters of the given types of amplifier coupling. 1d. Select relevant tuned amplifier for the given frequency band with justification. 1e. Describe the environment employed for the given simulation work with justification.	1.1 Classification of Amplifiers, BJT as an amplifier . 1.2 Single stage CE amplifier, frequency response, gain, bandwidth 1.3 Multistage amplifier: General Multistage amplifier BJT based. 1.4 Type of BJT amplifier coupling: Circuit diagram , operation, frequency response and applications of RC, transformer and direct coupling 1.5 FET Amplifier: Common Source amplifier, working principle and applications 1.6 Tuned Amplifier: Need of tuned amplifier, basic tuned circuit, circuit diagram, operating principle and frequency response of Single tuned, Double tuned and stagger tuned amplifiers

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– II High Power Amplifiers	2a. Explain with sketches the working of the given type of power amplifier. 2b. Select the relevant power amplifier for the given application with justification. 2c. Calculate efficiency of the given power amplifier. 2d. Compare the performance parameters of the given types of power amplifiers. 2e. Prepare the specifications of the given type of amplifier.	2.1 Power Amplifier: Comparison between small signal amplifier and power amplifier, performance parameter of power amplifier like : bandwidth, gain, frequency band, efficiency 2.2 Classification: Class A, Class B, Class AB and Class C 2.3 Circuit, operation, input /output waveforms, efficiency and power equations of Single Stage Class A, Class B, Class AB and Class C Power amplifier.
Unit III Feedback Amplifiers	3a. Calculate the gain of the amplifier for the given type of feedback amplifier. 3b. Explain effect of negative feedback on the given type of amplifier performance. 3c. Calculate Gain, Bandwidth, Input and Output resistance of the given feedback amplifier. 3d. Compare the performance of given types of negative feedback amplifiers.	3.1 Principle of feedback Amplifier 3.2 Types of feedback: negative and positive feedback, advantages and disadvantages of negative feedback 3.3 Types of feedback connections, voltage shunt, voltage series, current series and current shunt: block diagram, circuit diagram, and operation
Unit IV Wave form Generators	4a. Calculate frequency of oscillation for the given type of oscillator circuit. 4b. Select the relevant oscillator to obtain the given range of frequency with justification. 4c. Choose the relevant sweep generator to obtain the specified saw tooth waveform with justification. 4d. Prepare the specifications of the given oscillator.	4.1 Oscillators: Need, oscillator and amplifier 4.2 Condition for oscillation (Barkhausen's criteria), classification of oscillators 4.3 Sine wave Oscillator : RC Phase shift oscillator and crystal oscillator , concept , working and applications 4.4 Sweep generator: Miller sweep, Bootstrap circuit, current time base generator
Unit– V IC Voltage Regulators and SMPS	5a. Explain with sketches the working principle of given type of voltage regulator IC. 5b. Compare the working of the given types of regulators. 5c. Design voltage regulator for the specified output voltage. 5d. Interpret the working of given block of the SMPS.	5.1 Types of IC Voltage Regulator: Fixed and variable: 78XX, 79XX, specification, series and LM723, LM317, line and load regulation. 5.2 SMPS : Block diagram, working principle, specifications, special features, advantages , disadvantages and applications. Use of heat sink for regulated power supply.

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	Low Power Amplifiers	14	4	6	6	16
II	High Power Amplifiers	18	4	6	8	18
III	Feedback Amplifiers	12	4	4	4	12
IV	Waveform Generators	12	4	4	6	14
V	IC voltage Regulators and SMPS	08	2	4	4	10
Total		**64**	**18**	**24**	**28**	**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.*

10. 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: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Undertake micro-projects.
b. Give seminar on any relevant topic.
c. Library survey regarding different electronics circuits and voltage regulators.
d. Prepare power point presentation for electronic circuits.
e. Undertake a market survey of different electronics circuits and voltage regulators

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

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 student(s) in undertaking micro-projects.
f. Guide students for using data manuals.
g. Use PPTs to explain the construction and working of rectifier.
h. Use PPTs to explain the construction and working of wave shaping circuits.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably 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. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***
The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. 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. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs. Micro project report may be of four to five pages.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Construct a doorbell using transistor.
b. Using transistor construct a clap switch.
c. Construct audio amplifier using.(IC810 or equivalent IC).
d. Construct power amplifier for FM receiver output.
e. Drive a 4Ω speaker using class A amplifier which is directly coupled and test its performance parameters.
f. Using ClassAB push pull amplifier drive (4Ω/8Ω) speaker, test its performance parameters.
g. IC regulators: Build a circuit of Dual regulated power supply on general purpose PCB to obtain +/- 15 V, 500mA using IC 78XX & 79XX series.
h. IC regulators: Build a regulated power supply on general purpose PCB to obtain + 5V, 500mA using IC 78XX series. Drive suitable load with regulated output.
i. IC regulators: Build a regulated power supply on general purpose PCB to obtain -20V, 500mA using IC 79XX series. Use suitable heat sink .Drive suitable load with regulated output.
j. IC Regulators: Build a constant current regulator on general purpose PCB for output current of 125mA using IC 317.
k. IC Regulators : Construct low voltage regulator on general purpose PCB for output voltage 5V using LM IC 723.Drive any 5v operated load.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Applied Electronics	Sedha, R.S.	S.Chand, New Delhi, 2015 ISBN:9788121927833
2	Principles of Electronics	Mehta, V.K. Mehta, Rohit	S.Chand, New Delhi, 2014 ISBN:8121924502
3	Electronic Devices and Circuit Theory	Boylestead, Robert, Neshelsky, Louis	Pearson Education, New Delhi, 2014, ISBN: 9780132622264
4	Fundamental of Electronic Devices and	Bell ,David	Oxford University Press, New Delhi, 2015, ISBN:9780195425239

S. No.	Title of Book	Author	Publication
	Circuits		
5	Electronic Devices and Circuits	Millman, Jacob Halkias, C. Christos Jit, Satyabrata	Mc Graw Hill Education, New Delhi 2015, ISBN:9789339219550
6	Modern Power Electronics	Sen, P.C.	S.Chand, New Delhi, 2015 ISBN:9788121924252

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.eng.uokufa.edu.iq/staff/alikassim/lectures/CH-4.pdf
b. www.electronics-tutorials.ws/amplifier/amp_1.html
c. www.colorado.edu/ physics/phys3330/PDF/Experiment7.pdf
d. www.alldatasheet.com/view.jsp?Searchword=Bc147
e. www.williamson-labs.com
f. www.futurlec.com
g. www.learnerstv.com/video/Free-video-Lecture-870-Engineering.htm
h. www.electronicspost.com/discuss-the-essentials-of-a-transistor-oscillator-explain-the-action-of-tuned-collector-oscillator-colpitts-oscillator-and-hartley-oscillator/
i. www.radio-electronics.com/info/power-management/switching-mode-power-supply/basics-tutorial.php
j. www.circuitstoday.com/ic-723-voltage-regulators
k. www.onsemi.com/pub_link/Collateral/LM317-D.PDF