DARBHANGA COLLEGE OF ENGINEERING, DARBHANGA, BIHAR

COURSE FILE

OF

ANALOG ELECTRONICS

Faculty Name:

MR. SHAKTI PRASAD SENAPATI

ASSISTANT PROFESSOR, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

विज्ञान एवं प्रावैधिकी विभाग
Department of Science and Technology
Government of Bihar

CONTENTS

Vision of the Institute

To produce young, dynamic, motivated and globally competent Engineering graduates with an aptitude for leadership and research, to face the challenges of modernization and globalization, who will be instrumental in societal development.

Mission of the Institute

1. To impart quality technical education, according to the need of the society.
2. To help the graduates to implement their acquired Engineering knowledge for society & community development.
3. To strengthen nation building through producing dedicated, disciplined, intellectual & motivated engineering graduates.
4. To expose our graduates to industries, campus connect programs & research institutions to enhance their career opportunities.
5. To encourage critical thinking and creativity through various academic programs.

Vision of the Department

To bring forth engineers with an emphasis on higher studies and a fervour to serve national and multinational organisations and, the society.

Mission of the Department

M1: - To provide domain knowledge with advanced pedagogical tools and applications.

M2: - To acquaint graduates to the latest technology and research through collaboration with industry and research institutes.

M3: - To instil skills related to professional growth and development.

M4: - To inculcate ethical valued in graduates through various social-cultural activities.

PEO of EEE

PEO 01 – The graduate will be able to apply the Electrical and Electrical Engineering concepts to excel in higher education and research and development.

PEO 02 – The graduate will be able to demonstrate the knowledge and skills to solve real life engineering problems and design electrical systems that are technically sound, economical and socially acceptable.

PEO 03 – The graduates will be able to showcase professional skills encapsulating team spirit, societal and ethical values.

PSO of EEE

PSO 01 Students will be able to identify, formulate and solve problems using various software and other tools in the areas of Automation, Control Systems, Power Engineering and PCB designing.

PSO 02 Students will be able to provide sustainable solutions to growing energy demands.

Course Description

Through this course, the students acquire knowledge of amplifiers and oscillators. Develop the ability to analyze and design analog electronic circuits using discrete components. Observe the amplitude and frequency responses of common amplification circuits. This can prepare students to perform the analysis of any Analog electronics circuit. Empowering students, understanding the design and working of BJT / FET amplifiers, oscillators and Operational Amplifier can be done.

Course Objectives:

1. Understand the characteristics of transistors.
2. Design and analyse various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.

Course Outcomes:

CO1: Analyse of the CB, CE & CC amplifiers at Mid, Low and High frequencies using different models (Hybrid, Pi and T model).

CO2: Explain four ideal amplifiers, Darlington pair, cascade amplifier and multistage amplifier.

CO3: Analyse Incremental model of FET at low & high frequencies.

CO4: Classify power amplifiers and explain their working principles.

CO5: Classify oscillators and show the principle of operation.

CO-PO MAPPING

Sr. No.	Course Outcome	PO
1.	CO.1. Analyze of the CB, CE & CC amplifiers at Mid, Low and High frequencies using different models (Hybrid, Pi and T model).	PO1, PO2, PO3, PO4
2.	CO.2. Explain four ideal amplifiers, Darlington pair, cascade amplifier and multistage amplifier.	PO1, PO3, PO4
3.	CO.3. Analyze Incremental model of FET at low & high frequencies.	PO1, PO2, PO4
4.	CO.4. Classify power amplifiers and explain their working principles.	PO1, PO4
5.	CO.5. Classify oscillators and show the principle of operation.	PO1, PO2, PO3

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.1. Analyze of the CB, CE & CC amplifiers at Mid, Low and High frequencies using different models (Hybrid, Pi and T model).	√	√	√	√								
CO.2. Explain four ideal amplifiers, Darlington pair, cascade amplifier and multistage amplifier.	√		√	√								
CO.3. Analyze Incremental model of FET at low & high frequencies.	√	√		√								
CO.4. Classify power amplifiers and explain their working principles.	√			√								
CO.5. Classify oscillators and show the principle of operation.	√	√	√									

B. Tech. VI Semester (CSE)
CSE- 041404 Analog Electronics

L T P/D Total	Max Marks:	100	
3-0-3		Final Exam:	70 Marks
		Sessional:	20 Marks
		Internals:	10 Marks.

UNIT-I

Four ideal amplifiers: Ideal voltage amplifiers, ideal current amplifiers, ideal transresistance amplifiers and ideal transconductance amplifiers and distortions (amplitude or harmonic distortions, frequency distortion and phase distortion);

UNIT-II

Mid frequency amplifiers :

a. Analysis of CB,CE &CC amplifiers using hybrid model(chapter eight of integrated electronics by Millman & Halkias).

b. Low and High Frequency analysis of CB, CE & CC (Chapter 11 and Chapter 12 except Section 12-10 and 12-11.

c. rise time method for determination of fb using the formula of tr fh 0.35 and 10% sag method for the determination of flower using sag method.

UNIT-III

Bootstrapping in emitter follower, Darlington pair, cascade amplifier, CC-CB cascade.

UNIT-IV

Multistage amplifiers and band width shrinkage in multi stage amplifiers.

UNIT-V

Incremental model of FET and incremental analysis of common source at low & high frequencies.

UNIT-VI

Noise and noise figure in amplifiers: Thermal noise, shot noise, flicker noise, Friss formula

UNIT-VII

Class A, Class B and Class AB power amplifiers with reference to Complementary Symmetry Amplifiers.

UNIT-VIII

Barkhausen criteria and oscillator: Wien bridge, RC phase shift, quadrature, Hartley, Colpitts oscillator.

UNIT-IX

Tuned amplifiers-single tuned amplifiers

Text Books:

1. Micro Electronics by Millman And Grabel , McGRAW HILL
2. Electronic Devices and Circuits by Millman & Halkias , McGRAW HILL

Reference Books:

1. Micro electronics circuit by Sedra and Smith, Oxford University;
2. Micro electronics circuit analysis and design, by Rashid , PWS publication house;
3. Semi conductor circuit application- an introduction to transistors and IC’s by Malvino, TMH;
4. Electronic devices and integrated circuit- BP Singh and Rekha Singh, Pearson education
5. Electronic Principles, 7th Ed. by Albert Malvino & Davis J.Bates, TMH.

GATE SYLLABUS

Analog Electronics

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

DARBHANGA COLLEGE OF ENGINEERING, DARBHANGA **w.e.f. – 15-07-20**

CSE Semester – 3rd , Session (2019-23)

Day	Branch	1 (10am-10.50am)	2 (10.50am-11.40am)	3(11.40am-12.30pm)	4(12.30pm-1.20pm)	Lunch (1.20pm – 1.50pm)	5(1.50pm – 2.40pm)	6(2.40pm-3.30pm)	7(3.30pm-4.20pm)
Monday	CSE						AE	AE	
Tuesday	CSE.		AE						
Wednesday	CSE		AE						
Thursday	CSE								AE
Friday	CSE						AE LAB (E1)		
Saturday	CSE						AE LAB (E2)		

Mechanical – M1 - 1 to 30 **E.E.E. - E1 - 1 to 30** **C. Sc. - CS1 – 1 to30** **Civil - C1 – 1 to 30**
S-1 M2 –31 to All **S-2 E2 – 31 to All** **S-3 CS2 – 31 to All** **B.C.R. C2 – 31 to All**

Prof . Incharge Routine
D.C.E. Darbhanga

Principal
D.C.E., Darbhanga

S.N.	NAME	Reg No.	Class Roll N o.
1	16105111001	ANIL KUMAR	16-cs-73
2	16105111002	ABHAY PRAJAPATI	16-cs-63
3	16105111003	KESHAV KUMAR	16-cs-42
4	16105111004	ABHIMANYU KUMAR	16-cs-30
5	16105111005	NEHA RANJAN	16-cs-25
6	16105111006	RAHUL KUMAR	16-cs-21
7	16105111007	ABHINANDAN KUMAR	16-cs-69
8	16105111008	BASHISHTH KUMAR	16-cs-41
9	16105111009	SURAJ KUMAR	16-cs-05
10	16105111010	RAJ ROHIT KUMAR	16-CS-50
11	16105111011	CHANDRA BHUSHAN KUMAR	16-cs-62
12	16105111012	RANJEET KUMAR	16-cs-33
13	16105111013	MONIKA RAJ	16-cs-48
14	16105111014	RISHI RAJ	16-cs-40
15	16105111015	ANUJ PRIYADARSHI	16-cs-54
16	16105111016	MD DARWESH DASTAGIR	16-cs-61
17	16105111017	VIJETA KUMARI	16-cs-74
18	16105111018	KALPANA KUMARI	16-cs-45
19	16105111019	DEEPALI	16-cs-49
20	16105111020	MD IRSHAD IQUBAL	16-cs-36
21	16105111022	SARIKA RAJ	16-cs-32
22	16105111023	JYOTI KUMARI	16-cs-22
23	16105111024	MD ANAS	16-cs-64
24	16105111025	MOHIT KUMAR	16-cs-04
25	16105111026	MANISH NAG	16-cs-68
26	16105111027	MD DANISH REZA	16-cs-65
27	16105111028	MD ARIF	16-cs-71
28	16105111029	MD ZAFAR IQUBAL	16-cs-55
29	16105111030	RAJ GAURAV	16-cs-18
30	16105111031	KANAK	16-cs-57
31	16105111032	KANHAIYA KUMAR	16-cs-72
32	16105111033	SHWETA	16-cs-39
33	16105111034	VIKASH ANAND	16-cs-58
34	16105111035	SAKSHI SUMAN	16-cs-37
35	16105111036	SUPRIYA KUMARI	16-cs-38
36	16105111037	KUNDAN KUMAR	16-cs-20
37	16105111038	RAJESH CHOADHRI	16-cs-56
38	16105111039	KAINAT AYUB	16-cs-23
39	16105111040	VIVEK KUMAR	16-cs-67
40	16105111041	SHAYER KUMAR	16-cs-35
41	16105111042	MUKESH RAM	16-cs-66
42	16105111043	RAJ KUMAR YADAV	16-cs-59
43	16105111044	ANUPRIYA AYUSH	16-cs-19
44	16105111045	RITIKA RASHMI	16-cs-26
45	16105111046	RIA	16-cs-53
46	16105111047	SAURABH KUMAR	16-cs-52
47	16105111048	JYOTI KUMARI	16-cs-08
48	16105111049	RINKU KUMARI	16-cs-07
49	16105111050	KAUSHAL KUMAR MISHRA	16-cs-51

50	16105111051	MONU KUMAR SINGH	16-cs-10
51	16105111052	SARSWATI KUMARI	16-cs-60
52	16105111053	ORUSA	16-cs-46
53	16105111054	AMAN KUMAR	16-cs-44
54	16105111056	ANNU KUMARI	16-cs-31
55	16105111057	SURUCHI KUMARI	16-cs-47
56	16105111058	SATYAM KUMAR	16-cs-43
57	16105111059	ANKIT KUMAR	16-cs-01
58	16105111060	KALPANA KUMARI	16-cs-34
59	17105111902	SHUBHAM KUMAR	17-CS-LE-04
60	17105111903	VISHNU KUMAR CHAUDHARY	17-CS-LE-01
61	17105111904	SRISHTI MANDAL	17-CS-LE-02
62	17105111905	RAJU KUMAR	17-CS-LE-05

Institute/College Name:	Darbhanga College of Engineering
Program Name:	B.Tech
Course Code:	
Course Name:	Analog Electronics
Lecture/Tutorial(per week):	3/0
Course Credits:	
Course Co-coordinator Name:	Mr. Shakti Prasad Senapati

1. Scope and Objective of Course

An analogue signal uses some attribute of the medium to convey the signal's information. For example, an aneroid barometer uses the angular position of a needle as the signal to convey the information of changes in atmospheric pressure. Electrical signals may represent information by changing their voltage, current, frequency, or total charge. Information is converted from some other physical form (such as sound, light, temperature, pressure, position) to an electrical signal by a transducer which converts one type of energy into another (e.g. a microphone).

Since the information is encoded differently in analogue and digital electronics, the way they process a signal is consequently different. All operations that can be performed on an analogue signal such as amplification, filtering, limiting, and others, can also be duplicated in the digital domain. Every digital circuit is also an analogue circuit, in that the behavior of any digital circuit can be explained using the rules of analogue circuits.

Analogue systems invariably include noise that is random disturbances or variations, some caused by the random thermal vibrations of atomic particles. Since all variations of an analogue signal are significant, any disturbance is equivalent to a change in the original signal and so appears as noise. As the signal is copied and re-copied, or transmitted over long distances, these random variations become more significant and lead to signal degradation. Other sources of noise may include crosstalk from other signals or poorly designed components. These disturbances are reduced by shielding and by using low-noise amplifiers (LNA)

2. Textbooks

TB1: Integrated circuit by Millman And Halkias , McGRAW HILL
TB2: Micro Electronics by Millman And Grabel , McGRAW HILL

3. Reference Books

RB1: Micro electronics circuit by Sedra and Smith, Oxford University;

RB2: Micro electronics circuit analysis and design, by Rashid , PWS publication house;

RB3: Semi conductor circuit application- an introduction to transistors and IC ‘s by Malvino, TMH;

RB4: Electronic devices and integrated circuit- BP Singh and Rekha Singh, Pearson education

RB5: Electronic Principles, 7th Ed. by Albert Malvino & Davis J.Bates, TMH.

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Other readings and relevant websites

S. No.	Link of journals, Magazines, websites and Research papers
1.	http://ieeexplore.ieee.org/document/5269097/
2.	http://ieeexplore.ieee.org/document/7252081/

Course plans

Lecture No.	Date of Lecture	Topics	Web Links for Videos Lecture	Text Books/Reference books/Reading Materials	Page No. of Text Books
1-3	15/02/18 to 22/02/18	Four ideal amplifiers Ideal voltage amplifiers, ideal current amplifiers, ideal trans-resistance amplifiers and ideal trans-conductance amplifiers and distortions (amplitude or harmonic distortions, frequency distortion and phase distortion.) .	https://www.youtube.com/watch?v=5hc5SaD2360	RB1: Micro electronics circuit by Sedra and Smith, Oxford University	5-46

4-13	23/02/18 to 17/03/18	Mid frequency amplifiers Analysis of CB, CE & CC amplifiers using hybrid model. Low and High Frequency analysis of CB, CE & CC. Rise time method for determination of f_b using the formula of t_r f_h – 0.35 and 10% sag method for the determination of f_{lower} using sag method.	https://www.youtube.com/watch?v=QJG6RrkWHME	TB1: Integrated circuit by Millman And Halkias , McGRAW HILL	233-245, 282-308
14-16	22/03/18 to 24/03/18	Bootstrapping in emitter follower Darlington pair, cascade amplifier, CC-CB cascade.	https://www.youtube.com/watch?v=tTPRbtJJV0o	TB1: Integrated circuit by Millman And Halkias , McGRAW HILL	282-295
17-18	29/03/18 to 30/03/18	Multistage amplifiers Band width shrinkage in multi stage amplifiers.	https://www.youtube.com/watch?v=-bz6u7IF1gM v=ds0hcTZNDxc	RB1: Micro electronics circuit by Sedra and Smith, Oxford University	749-758
19-20	31/03/18 to 05/04/18	Incremental model and Analysis FET and common source at low & high frequencies.	https://www.youtube.com/watch?v=muvucBFQzMw	TB1: Integrated circuit by Millman And Halkias , McGRAW HILL	310-353
21-23	06/04/18 to 12/04/18	Noise and noise figure in amplifiers Thermal noise, shot noise, flicker noise, Friis formula.	https://www.youtube.com/watch?v=Y2NOxF9ATII	RB1: Micro electronics circuit by Sedra and Smith, Oxford	738-746

				University HILL	
24-27	13/04/18 to 20/04/18	Class A, Class B and Class AB power amplifiers Reference to Complementary Symmetry Amplifiers.	https://www.youtube.com/watch?v=RyXWXKuajUo	RB1: Micro electronics circuit by Sedra and Smith, Oxford University	1229-1240
28-31	21/04/18 to 25/04/18	Barkhausen criteria and oscillator Wien bridge, RC phase shift, quadrature, Hartley, Colpitts oscillator	https://www.youtube.com/watch?v=LZvxSReL0ws	RB1: Micro electronics circuit by Sedra and Smith, Oxford University	1166-1182
31-34	26/04/18 to 30/04/18	Tuned amplifiers. Single Tuned Amplifier	https://www.youtube.com/watch?v=XQ3TJsYdtTY	RB1: Micro electronics circuit by Sedra and Smith, Oxford University	1141-1147

Syllabus

Topics	No. of Lectures	Weightages
Four ideal amplifiers: Ideal voltage amplifiers, ideal current amplifiers, ideal trans-resistance amplifiers and ideal trans-conductance amplifiers and distortions (amplitude or harmonic distortions, frequency distortion and phase distortion).	**4**	10%
Mid frequency amplifiers: a. Analysis of CB, CE &CC amplifiers using hybrid model(chapter eight of integrated electronics by Millman & Halkias). **b.** Low and High Frequency analysis of CB, CE & CC (Chapter 11 and Chapter 12 except Section 12-10 and 12- 11. **c.** Rise time method for determination of f_b using the formula of t_r f_h – 0.35 and 10% sag method for the determination of f_{lower} using sag method.	**15**	24%
Bootstrapping in emitter follower, Darlington pair, cascade amplifier, CC-CB cascade.	**4**	10%
Multistage amplifiers and band width shrinkage in multi stage amplifiers.	**3**	08%
Incremental model of FET and incremental analysis of common source at low & high frequencies.	**3**	08%
Noise and noise figure in amplifiers : Thermal noise, shot noise, flicker noise, Friis formula	**4**	10%
Class A, Class B and Class AB power amplifiers with reference to Complementary Symmetry Amplifiers.	**5**	10%
Barkhausen criteria and oscillator : Wien bridge, RC phase shift, quadrature, Hartley, Colpitts oscillator	**6**	10%
Tuned amplifiers-single tuned amplifiers.	**4**	10%

Evaluation and Examination Blue Prints:

Internal assessment is done through quiz tests, presentations, assignments and projects work. Two sets of question paper are asked from each faculty and out of these two, without the knowledge of faculty, one question paper is chosen for the concerned examination. Examination rules and regulations are uploaded on the student's portals. Evaluation is a very transparent process and the answer sheets of seasonal tests, internal assessment assignments are returned back to the students.

The components of evaluation along with their weightage followed by the university are given below:

Component-1	Sessional test-1	30%
	Sessional test-2	
	Sessional test-3	
Component-2	Assignments, Quiz's, Test, Seminars	10%
Component-3	End Term Examination	60%
Totals		100%

Designation	**Name**	**Signature**
Course Coordinator	Mr. Shakti Prasad Senapati	
H.O.D	Mr. Prabhat Kumar	
Principal	Prof. Achintya	
Date	…../…./……….	

Institute/College Name:	Darbhanga College of Engineering
Program Name:	B.Tech
Course Code:	
Course Name:	Analog Electronics
Lecture/Tutorial(per week):	3/0
Course Credits:	5
Course Co-coordinator Name:	Mr. Shakti Prasad Senapati

Lecture Plan

Topics	**No. of Lectures**
Four ideal amplifiers: Ideal voltage amplifiers, ideal current amplifiers, ideal trans-resistance amplifiers and ideal trans-conductance amplifiers.	**2**
Distortions (amplitude or harmonic distortions, frequency distortion and phase distortion).	**2**
Low Frequency analysis of CB, CE & CC. r_e- Model of BJT	**3**
High Frequency analysis of CB, CE & CC. Analysis of CB, CE &CC amplifiers using hybrid model(chapter eight of integrated electronics by Millman & Halkias).	**5**
Problems on r_e- Model and hybrid model of BJT	**2**
Rise time method for determination of f_b using the formula of t_r f_h – 0.35	**3**
10% sag method for the determination of f_{lower} using sag method	**2**
Bootstrapping in emitter follower	**2**
Darlington pair, cascade amplifier, CC-CB cascade.	**2**

Introduction to Multistage amplifiers	**2**
Band width shrinkage in multi stage amplifiers.	**1**
Incremental model of FET (Common Source, Common Drain and Common Gate)	**2**
Incremental analysis of common source at low & high frequencies	**1**
Noise and noise figure in amplifiers : Thermal noise, shot noise, flicker noise, Friis formula	**4**
Introduction to Class A, Class B and Class AB power amplifiers.	**3**
Complementary Symmetry Amplifiers	**2**
Barkhausen criteria and oscillator : Introduction to Oscilator**,** Wien bridge,	**3**
RC phase shift, Quadrature Oscillotor	**2**
Hartley, Colpitts oscillator	**1**
Tuned amplifiers-single tuned amplifiers.	**4**

Department of EEE,
DCE, Darbhanga
Analog Electronics

Assignment I

1. Determine gain bandwidth product, unity gain frequency using hybrid model for CE configuration.

2. Draw the circuit diagram of emitter follower at high frequencies. Also explain its behavior at high frequencies with necessary expression and parameter?

3. What is a parallel resonance? What are its features? How is it different from series resonances?

4. Explain the frequency response of stagger tuned amplifier?

Assignment II

1. What do you understand by class A, B and C power amplifiers?

2. Draw the circuit diagram of a push pull amplifier. Explain its operation. Discuss its advantages and disadvantages.

3. What are the four possible topologies of a feedback amplifier? Identify the output signal X_o and feedback signal X_f for each topologies (either as current or voltage).

Assignment III

1. Discuss with the help of a circuit example, the purpose of providing

(i) Negative Feedback (ii) Positive Feedback in amplifier

2. State the barkhausen conditions for an electronic system to oscillate with feedback.

3. Sketch the circuit for a wein bridge oscillator. What determines the frequency of oscillation? Will oscillations take place if the bridge is balanced?

4. Draw the circuit diagram of an RC phase shift oscillator and obtain an expression for its frequency of oscillation.

Department of EEE
Analog Electronics

Tutorial I

1. A transistor used in CE connection has the following set of h parameters when the d.c. operating point is V_{CE} = 5V and I_C = I rnA, h_{ie} =1700Ω, h_{re} = 1.3 x 10^{-4} , h_{fe} = 38; h_{oe} = 6* $l0^{-6}$℧. If the a.c. load r_L seen by the transistor is 2KΩ. Find (i)the input impedance (ii) current gain (iii) voltage gain.
2. A multistage amplifier consists of three stages; the voltage gain of the stages are 60,100 and 160 calculate the overall gain.
3. A multistage amplifier employs 4 stages each of which has a power gain of 20. What is the total gain of the amplifier in dB?
4. The input power to an amplifier is 10 mw while output power is 1.5 W. Find the gain of the amplifier.
5. The absolute gain of an amplifier is 30; find its decibel in gain.
6. An amplifier with negative feedback has a voltage gain of 100. It is found that without feedback an input signal of 50mV is required to produce a given output, whereas with feedback, the-input signal must be 0.6V for same output. Calculate the value of A and β.
7. When negative voltage feedback is applied to an amplifier of gain 100, the overall gain falls to 50. Calculate the feedback factor.

Tutorial II

1. Design a Wein bridge oscillator circuit to produce a 100 KHz, 9Vouput. Design amplifier to have closed loop gain of 3.
2. What is the basic principle of RC oscillators? Design a phase shift oscillator to oscillate at 500Hz.
3. A crystal has the following parameters L= 0.33H, C_1= 0.065pF, C2 = l pF and R=5.5KΩ. Determine series resonant frequency and Q factor of the crystal.
4. A Colpitt's oscillator is design with C_1=100 Pf and C_2 =7500 Pf. The inductance is variable. Determine the range of inductance values, if the frequency of oscillation is to vary between 750 kHz and 2050 kHz.
5. For a class B power amplifier using a supply of V_{CC}= I2V and driving a load of 8Ω, Determine maximum load power. DC input power and collector efficiency.
6. The gain and distortion of an amplifier are 150 and 5 % respectively, without feedback. If the stage has 10 % of its output voltage applied as negative feedback, find the distortion of the amplifier with negative feedback.

Code : 041404

B.Tech 4th Semester Examination, 2017

Analog Electronics

Time : 3 hours *Full Marks : 70*

Instructions :

(i) *There are Nine Questions in this Paper.*

(ii) *Attempt Five questions in all.*

(iii) *Question No. 1 is Compulsory.*

(iv) *The marks are indicated in the right-hand margin.*

1. Answer any seven (7) questions out of ten (10). $2\times7=14$

(i) The maximum efficiency of Class B amplifier is:

(a) 90%

(b) 78.5%

(c) 98%

(d) 10%

(ii) Which relationship between the h-parameters is WRONG?

(a) $h_{re} = h_{oc}$

(b) $h_{rc} = 1$

(c) $h_{ic} = h_{ie}$

(d) $h_{oc} = 1/h_{oe}$

(iii) Which of the following is the correct values of hybrid- π model parameters (C_r & C_e) at $IC = 1.3$ mA:

P.T.O.

(a) 3 pF & 100 pF

(b) 300 pF & 1 pF

(c) 30 pF & 10 pF

(d) 0.03 pF & 1000 pF

(iv) Which of the following distortion in amplifier result from the production of new frequencies in the output which are not present in the input signal?

(a) Frequency distortion

(b) Phase-shift distortion

(c) Non-linear distortion

(d) None of these

(v) The input impedance (Z_i) and the output impedance (Z_o) of an ideal trans-conductance (voltage controlled current source) amplifier are:

(a) $Z_i = 0,\ Z_o = 0$

(b) $Z_i = 0,\ Z_o = \infty$

(c) $Z_i = \infty,\ Z_o = 0$

(d) $Z_i = \infty,\ Z_o = \infty$

(vi) Oscillators are working on the principle of:

(a) Positive feedback

(b) Negative feedback

(c) Any of positive or negative feedback

(d) None of these

(vii) Impact of current shunt feedback topology is:

(a) Both input and output resistances decreases

(b) Both input and output resistances increases

(c) Input resistance increases, but output resistance decreases

(d) Input resistance decreases, but output resistance increases

(viii) Cascading of non-interacting amplifier stages usually results in:

(a) Increase in overall bandwidth

(b) Decrease in overall bandwidth

(c) Decrease in overall gain

(d) None of these

(ix) For the feedback amplifier to be stable, its poles must all be in the:

(a) Left half of the s-plane

(b) Right half of the s-plane

(c) Any where in the s-plane

(d) None of these

(x) For the approximate analysis of low-frequency transistor circuits, two of the four h-parameters (h_{ie} and h_{fe}) are sufficient under which of the following condition.

(a) $h_{oe} R_L < 0.1$

(b) $h_{oe} R_L > 0.1$

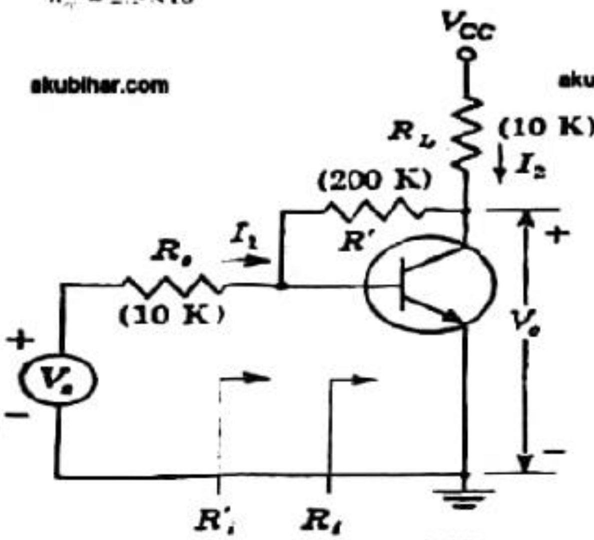
(c) $h_{ie} = h_{fe}$

(d) All of these

Answer any Four (4) from the remaining Eight (8) Questions.

2. (a) Determine the parameter h_{fe} in terms of the CB h-parameters. 6

(b) For the amplifier shown in the figure below, Calculate R_i, R_i', A_I, A_V, A_{Vs}, $A_I = \frac{I_2}{I_1}$. Assume $h_{fe} = 50$, $h_{ie} = 1100\,\Omega$, $h_{re} = 24 \times 10^{-4}$ A/V, and $h_{oe} = 2.5 \times 10^{-4}$



3. (a) With the help of suitable figures(s), discuss trans-resistance amplifier. Determine the expression for its input current, output voltage, and loaded trans-resistance gain. 8

(b) Draw hybrid-π model for a transistor in the CE configuration. Discuss the circuit components. 6

4. (a) Consider an emitter follower. Neglect h_{re} and show that as $R_L \to \infty$

(i) $R_i \to h_{ie} + (1 + h_{fe}) / h_{oe} \approx 1/h_{ob}$

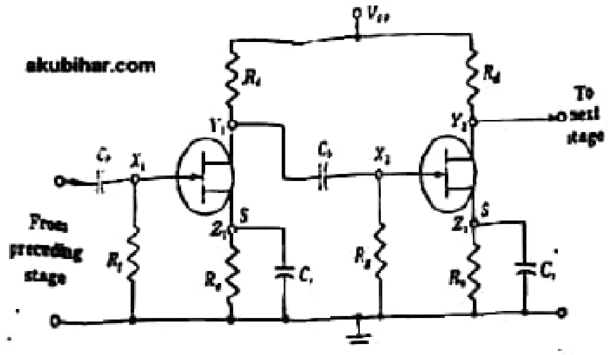
(ii) $1 - AV \approx h_{ie} h_{oe} / (1 + h_{fe})$

Evaluate Av. Assume $h_{fe} = 50$, $h_{ie} = 1100\,\Omega$, $h_{re} = 24 \times 10^{-4}\,A/V$, and $h_{oe} = 2.5 \times 10^{-4}$. 7

(b) Describe the Rise time and Tilt (Sag).

Find the *rise time* for an amplifier with 1 MHz bandpass. Also, find the per cent *tilt*, if we wish to pass a 50-Hz square wave with lower 3-dB frequency of 1.0 Hz. 7

5. (a) A two-stage FET RC-coupled amplifier has the following parameters: g_m = 10 mA/V, r_d = 5.5 KΩ, R_d=10 KΩ and R_g=0.5 MΩ for each stage. Assume C_s in the figure below to be arbitrarily large. *(i)* What must be the value of C_s in order that the frequency characteristics of each stage be flat within 1 dB down to 10 Hz? *(ii)* repeat part *(i)* if the overall gain of both stages is to be down 1 dB at 10 Hz? *(iii)* What is the overall mid-band voltage gain?



(b) Sketch the circuit of a push-pull class B transistor amplifier in the common-collector configuration without an output transformer. 2

6. (a) Derive the expression for the CE short-circuit current gain A_i as a function of frequency. 7

(b) Given the following transistor measurements made at $I_C = 5\text{mA}, V_{CE} = 10\text{V}$, and at room temperature; $h_{fe} = 100$, $h_{ie} = 600$ ohms, $[A_{ie}] = 10$ at 10 MHz, $C_c = 3$ pF. Find $f_\beta, f_T, C_e, r_{b'e}, r_{bb'}$, b. The symbols used have their usual meaning.

7. (a) Define and discuss the positive feedback. Also give two *Barkhausen conditions* required in order for sinusoidal oscillations to be sustained. 7

(b) Discuss the classification of amplifiers according to method of operations. 7

8. (a) With the help of suitable diagram(s), describe the Wien bridge oscillator. 7

(b) An amplifier with an open-loop voltage gain of 1000 delivers 10 W of output power at 10 per cent second-harmonic distortion when the input signal is 10 mV. If 40-dB negative-series feedback is applied and the output power is to remain at 10 W, determine (i) the required input signal, (ii) the per cent harmonic distortion. 7

9. (a) Design a phase-shift oscillator to operate at a frequency of 5 kHz. Use a MOSFET with $\mu = 55$ and $r_d = 5.5$K. The phase-shift network is not to load down the amplifier. (i) Find the minimum value of the drain-circuit resistance R_d for which the circuit will oscillate, (ii) Find the product RC, (iii) Choose a reasonable value for R, and find C. 9

(b) With the help of suitable diagram(s), discuss the Tuned amplifier. 5

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7. (a) Design the Collpitt's oscillator and explain with help of circuit diagram. Derive the expressions for frequency of oscillation and condition for oscillation, respectively. 6

   (b) Drive the formula $f_t = h_{fe} f_H \, f_\beta$, where f_T is gain-bandwidth product, h_{fe} is current gain, and f_β is bandwidth of amplifier in CE configuration respectively. 8

8. (a) Derive expression for current gain in case of amplifier in CE configuration and operated at high frequency (assume output is short circuited). 6

   (b) Draw the circuit diagram of class A transformer coupled power amplifier and compute the conversion efficiency using mathematical analysis. 8

9. (a) Write down difference between tuned amplifier and amplifier having resistive load with help of circuit diagram and transfer functions. 6

   (b) Derive expression for tilt/sag in the output of amplifier acting as high pass circuit (CR circuit) and operated at input step input voltage signal. 8

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Code : 041504

B.Tech 5th Semester Examination, 2016

Analog Electronics

Time : 3 hours *Full Marks : 70*

Instructions :

(i) There are Nine Questions in this paper.

(ii) Attempt Five questions in all.

(iii) Question No. 1 is compulsory.

(iv) The marks are indicated in the right-hand margin.

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1. Answer the following questions in brief preferably in one/two line (any seven): 2×7=14

   (a) Write two applications of oscillators.

   (b) Which configuration has highest output impedance in case of equivalent circuit of BJT at low frequency in CE, CB, and CC configuration?

   (c) In CE amplifier operated at low frequency, what is the phase shift of output current to this input current?

   (d) List two types of feedback used in the amplifier.

   (e) What are the Barkhausan criteria for oscillation?

(f) Which harmonics are present in the output in case of Class B push-pull power amplifier?

(g) What is the advantage of CC-CE configuration?

(h) What is the advantage of CE-CB configuration?

(i) Write down the formula that relates rise time and high cut off frequency in case of amplifier behaving as low pass circuits at higher frequency.

(j) Write mathematical expression for harmonic distortion.

2. (a) Discuss about ideal voltage amplifiers and ideal current amplifier with diagram and transfer characteristics. 6

(b) Discuss about frequency and phase distortions, respectively with help of mathematical expressions. 8

3. (a) Write the effect of cascading the CE-CC two stages of amplifiers in term of input impedance, output impedance, current gain and voltage gain over individual stages. 6

(b) Derive the expression for voltage gain in case of CE amplifier with emitter resistance R_e operated at low frequency. 8

4. (a) Derive expression for upper cut off frequency in case of cascade amplifier, also computer the upper cut off frequency if individual stage upper cut off frequency is 4 MHz and number of cascaded stages are 10. 6

(b) Derive formula: $t_r=0.35/f_H$, where t_r is rise time and f_H is high cut off frequency. Above formula needs to be derived for step input applied to the amplifier that is acting as low pass RC circuit at high frequency. 8

5. (a) Write down about any two of the following with help of mathematical expressions. 6

(i) Thermal noise

(ii) Shot Noise

(iii) Flicker noise

(b) Derive voltage gain for common source FET amplifier operated at low frequency. 8

6. (a) Draw circuit diagram of Wein bridge oscillator and derive the expression for its frequency of oscillation.

(b) Explain working of class AB power amplifier with help of circuit diagram and also draw its input-output characteristics curve. 8

9. Write short notes on any *two* of the following : 7×2=14

   (a) High-frequency amplifier

   (b) Flicker noise

   (c) R-C phase shift oscillator

* * *

Code : 041504

B.Tech 5th Semester Exam., 2015

ANALOG ELECTRONICS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** *questions in this paper.*

(iii) Attempt **FIVE** *questions in all.*

(iv) Question No. **1** *is compulsory.*

1. Answer any *seven* of the following : 2×7=14

   (a) Explain the role of amplifiers. Write the name of five types of amplifier.

   (b) Explain the importance of gain bandwidth product.

   (c) Demonstrate the *h*-parameter.

   (d) Illustrate the difference between β_p and β_n.

   (e) Draw the circuit for Darlington pair.

   (f) Illustrate the −3dB cut-off frequency.

   (g) Define the difference between oscillator and amplifier.

(h) Demonstrate the use of Wien bridge oscillator.

(i) Determine the input impedance of OPAMP.

(j) Explain noise figure and signal-to-noise ratio.

2. (a) Derive the expression for collector current. Define the CB, CE and CC configurations. Establish the relation between α, β and γ. 7

(b) Define ideal voltage amplifier, current amplifier and ideal transconductance amplifier. 7

3. (a) Explain Darlington pair in detail with suitable circuit diagram and mathematical expressions. 7

(b) Define the low-pass and high-pass filter, and calculate its cut-off frequencies and magnitude. 7

4. (a) Demonstrate the equivalent circuit for an emitter follower stage at high frequencies. 7

(b) A three-stage system voltage gain is 180 dB. The second-stage has twice of first-stage and third has 0·3 times of first. Calculate the voltage gain of the system in each stage. 7

5. (a) Design the Wien bridge oscillator and derive the mathematical expression for calculation of the frequencies. 7

(b) Explain the transmission path loss. Derive the Friis transmission formula and define all the terms. 7

6. (a) Define Hartley and Colpitts oscillator. Design T- and star-network, and calculate the input and output impedance. 7

(b) In Colpitts oscillator the value of C_1 and C_2 are in the ratio of 20 µF/2 µF. Calculate the value of inductance for oscillation frequency 100 kHz. 7

7. (a) Explain the noise. Explain the difference between thermal noise and flicker noise. 7

(b) Define tuned amplifier with suitable diagram. 7

8. (a) Demonstrate class *AB* amplifier in detail with suitable mathematical expression and diagram. 7

(b) A transformer-coupled class *A* amplifier drives a load of 18 Ω through 4 : 1 transformer. With $V_{CC} = 25$ V, the circuit derives 3 watt to the load. The transformer efficiency is 85%. Find power loss of the primary transformer and r.m.s. value of load current. 7

Code : 041504

B.Tech 5th Semester Exam., 2014

ANALOG ELECTRONICS

Time : 3 hours | ***Full Marks*** : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Answer any *seven* of the following : $2\times7=14$

   (a) What is an amplifier? What are various types of amplifiers?

   (b) Compare between frequency distortion and phase distortion.

   (c) What is the importance of hybrid parameters?

   (d) In a common emitter with a non-zero load resistance, the current gain bandwidth product reduces as load resistance increases. Why?

(e) Why is the input impedance of a Darlington emitter follower higher than that of a single-stage emitter follower?

(f) How does the number of stages in a multistage amplifier influence the cut-off frequencies?

(g) How are the amplifiers classified based on the biasing condition?

(h) Explain any one application of phase inverter circuit.

(i) What determines the frequency of oscillation in Wien bridge oscillator?

(j) Define noise figure and signal to noise ratio.

2. (a) Derive the equations for voltage gain, current gain, input impedance and output impedance for a BJT using low frequency h-parameter model for CB configuration. 8

(b) A transistor in CE configuration is driven by a voltage source V_S of internal resistance $R_S = 1\ k\Omega$. The load impedance is a resistor $R_L = 1\ k\Omega$. The h-parameters are $h_{ie} = 1 \cdot 1\ k\Omega$, $h_{re} = 2 \cdot 8 \times 10^{-4}$, $h_{oe} = 24\ \mu$ mho and $h_{fe} = 55$. Calculate A_i, Z_i, A_v. 6

3. (a) The input to a low-pass amplifier is a pulse of width t_p. Sketch the output waveshape. What must be the relationship between t_p and f_H in order to amplify the pulse without excessive distortion? 8

(b) Consider function of an amplifier with poles at 1 MHz and 2 MHz. Assume all the other poles and zeros are much larger than 2 MHz. Calculate the high 3-dB frequency. 6

4. (a) Draw the small signal equivalent circuit for an emitter follower stage at high frequencies. 7

(b) The total decibel voltage gain of a three-stage system is 120 dB. The second stage has twice the decibel voltage gain of first stage and the third has 2·7 times the decibel gain of the first. Calculate the decibel voltage of each stage. 7

5. (a) Discuss different types of noises in an amplifier briefly. What effect does noise have in an amplifier used in audio or video application? 7

(b) Explain the term 'path loss'. Derive the Friss transmission formula. 7

6. *(a)* Sketch the topology for a generalized resonant circuit oscillator using impedances Z_1, Z_2 and Z_3. At what frequency will the circuit oscillate? Under what condition does the configuration reduce to a Colpitt's oscillator and a Hartley oscillator? 7

(b) In the Colpitt's oscillator, $C_1 = 0 \cdot 2\ \mu F$ and $C_2 = 0 \cdot 02\ \mu F$. If the frequency of oscillation is 10 kHz, find the value of inductor. Also find the required gain for oscillation. 7

7. *(a)* Describe the construction of a phase-shift oscillator and explain its working. How is the feedback requirements met in it? 7

(b) An *R-C* phase-shift oscillator uses a bipolar junction transistor with $h_{fe} = 100$. If $R_C = 10\ k\Omega$, $R = 2\ k\Omega$ and $C = 0 \cdot 1\ \mu F$, will this circuit oscillate? If yes, find the oscillation frequency. 7

8. *(a)* Describe crossover distortion, what it is caused by, and how it is overcome. What penalty is paid for biasing an amplifier into class AB operation? 7

(b) A transformer coupled class A amplifier drives a load of 8 Ω through 3 : 1 transformer. With $V_{CC} = 24$ V, the circuit delivers 2 W to the load. The transformer efficiency is 80%. Find *(i)* power across the transformer primary and *(ii)* r.m.s. values of load current and primary current. 7

9. Write short notes on any *two* of the following : 7×2=14

(a) Low-frequency incremental model for a common source FET

(b) Darlington pair

(c) Quadrature oscillator

* * *

Code : 041404

2013

ANALOG ELECTRONICS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** *questions in this paper.*

(iii) Attempt **FIVE** *questions in all.*

(iv) Question No. 1 is compulsory.

1. Answer any seven of the following : $2 \times 7 = 14$

(a) What are the salient features of hybrid parameters?

(b) A BJT has $C_\mu = 1$ pF. If $g_m = 50$ mA/V, calculate f_T of a common-emitter amplifier using this BJT.

(c) What is inter-modulation distortion in amplifier?

(d) Write down the transfer function of a simple RC low-pass circuit.

(e) Under what condition, output of an amplifier preserves the form of input signal?

(f) What are tuned amplifiers?

(g) Explain how the conduction angle in class C amplifier is maintained.

(h) Why are power transistors provided with heat sinks?

(i) Define Q factor of a resonant circuit.

(j) What are the constituent parts of an oscillator?

2. (a) Draw the equivalent circuit for the CE and CC configurations subject to the restriction that input is open circuited. Show that output impedances of the two circuits are identical. 8

(b) A transistor is used in CB amplifier with $R_L = 150$ kohm and $R_S = 10$ ohm. The h-parameters are $h_{ib} = 40$ ohm, $h_{rb} = 3 \times 10^{-4}$, $h_{ob} = 1\mu$ mho, $h_{fb} = 0 \cdot 98$. Calculate A_i, Z_i, A_v. 8

3. (a) Draw and explain the small-signal high-frequency CE model of a transistor. 6

(b) Following low frequency parameters are known for a given transistor at $I_C = 10$ mA, $V_{CE} = 10$ V and at room temperature :

$$h_{ie} = 500 \text{ ohm}, \ h_{re} = 10^{-4}$$

$$h_{oe} = 4 \times 10^{-5} \text{ A/V}, \ h_{fe} = 100$$

At some operating point, $f_T = 50$ MHz and $C_{ob} = 3$ pF, compute the values of all the hybrid-π parameters. 8

4. (a) Derive the expression for the CE short-circuit current gain as a function of frequency. 8

(b) What are multistage amplifiers? Why do we need these amplifiers? Derive the equation of overall gain of a multistage amplifier in terms of the gain of individual stage in dB. 6

5. (a) Sketch the response of an amplifier to a low-frequency square wave. Define the term tilt. How is the tilt related with the low 3 dB frequency f_L? 7

(b) Three identical cascaded stages have an overall upper 3 dB frequency of 20 kHz and a lower 3 dB frequency of 20 Hz. What are f_L and f_H of each stage? Assume non-interacting stages. 7

6. *(a)* What are the advantages of push-pull arrangement of amplifier? Draw its circuit and explain the working. 6

   (b) In a class A amplifier, $V_{CE\,min} = 5\,V$, $V_{CE\,max} = 25\,V$. Find the overall efficiency for *(i)* series fed load and *(ii)* transformer coupled load. 8

7. *(a)* A tank circuit has a capacitor 100 pF and an inductor 100 μH. The resistance of the inductor is 5Ω. Determine the resonant frequency, impedance at resonance, *Q* factor and bandwidth of this tank circuit. 7

   (b) Explain the principle and describe the working of a shunt-fed Hartley oscillator. 7

8. *(a)* A class A power amplifier uses a transformer as a coupling device. The transformer has a turn ratio of 10 and the secondary load is 10Ω. If the zero signal collector current is 100 mA, find the maximum power output. 7

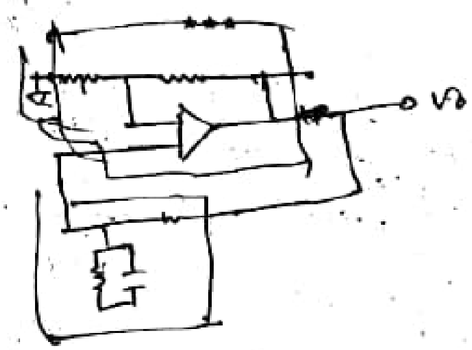
   (b) Draw the Wien bridge oscillator circuit and derive the expression for frequency of oscillation. 7

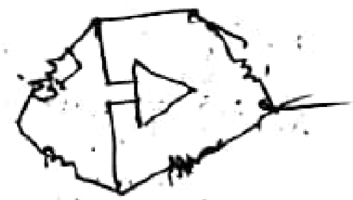
9. Write short notes on any *two* of the following: 7×2=14

   (a) Harmonic distortion in amplifier

   (b) Incremental model of FET

   (c) Ideal voltage and trans-resistance amplifiers





Shubhendu 11EE56

Quality Measurement Sheets

a. Course End Survey

ACADEMIC YEAR: 2020-21	SEM: V	DATE:
COURSE: Analog Electronics	CLASS: EEE	FACULTY: SHAKTI PRASAD SENAPATI

Please evaluate on the following scale:

Excellent(E)	Good(G)	Average(A)	Poor(P)	No Comment(NC)
5	4	3	2	1

SNO	QUESTIONAIRE	E 5	G 4	A 3	P 2	NC 1	Avg %
GENERAL OBJECTIVES:							
1	Did the course achieve its stated objectives?						
2	Have you acquired the stated skills?						
3	Whether the syllabus content is adequate to achieve the objectives?						
4	Whether the instructor has helped you in acquiring the stated skills?						
5	Whether the instructor has given real life applications of the course?						
6	Whether tests, assignments, projects and grading were fair?						
7	The instructional approach (es) used was (were) appropriate to the course.						
8	The instructor motivated me to do my best work.						
9	I gave my best effort in this course						
10	To what extent you feel the course outcomes have been achieved.						
Please provide written comments:							

a) What was the most effective part of this course

b) What are your suggestions, if any, for changes that would improve this course?

c) Given all that you learned as a result of this course, what do you consider to be most important?

d) Do you have any additional comments or clarifications to make regarding your responses to any particular survey item?

e) Do you have any additional comments or suggestions that go beyond issues addressed on this survey?

TEACHING EVALUATION

DARBHANGA COLLEGE OF ENGINEERING

Department of ELECTRICAL & Electronics Engineering,

Course Assessment

ACADEMIC YEAR: 2020-21	SEM: V	DATE:
COURSE: Analog Electronics	CLASS: EEE	FACULTY: SHAKTI PRASAD SENAPATI

Assessment	**Criteria Used**	**Attainment Level**			**Remarks**
Direct (d)	**Theory**				
	External Marks	___			
	Internal Marks (Theory)				
	Assignments				
	Tutorials				
Indirect (id)	**Course End Survey**				
Theory: Course Assessment (0.6 × d+ 0.4 × id)					