UNIVERSITY OF CALCUTTA

SYLLABI

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THREE YEAR B. Sc HONOURS

AND

GENERAL COURSES

IN

ELECTRONICS

2010

GENERAL COURSE

DISTRIBUTION OF MARKS

Part-I Examination (1st year) **Full Marks: 100**

Module I

Paper IA: Electronic Circuits and Basic Electronics-I 50

Module II

Paper IB: Basic Electronics-II 50

Part-II Examination (2nd year) **Full Marks: 200**

Module I

Paper IIA: Digital Electronics and Instrumentation 50

Module II

Paper IIB: Electronic Communication 50

Paper IIIA: Practical (Electricity and Analog Electronics) 50

Paper-IIIB : **Practical** (Digital Electronics) 50

Part-III Examination (3rd year) **Full Marks: 100**

Module I

Paper-IVA: Introduction to 8085 Microprocessor 50
and Computer Programming

Module II

Paper-IVB: **Practical** 50

Group A: 8085 Assembly Language Programming 30

Group B: C Programming 20

Total marks for General Course: **400**

Theoretical papers: **250**

Practical papers: **150**

Guidelines for practical classes:

In practical classes all the data should be recorded directly in the Laboratory Note Book and signed regularly by the attending teachers. The student has to submit this Note Book at the time of final Practical Examination. No separate fair LNB needs be maintained.

GENERAL COURSE

QUESTION PATTERNS

Part-I Examination **Full Marks 100**

Paper-IA **Full Marks-50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of Questions

Unit	Topics	No. of questions to be set
I	Electric Circuits	4
II	Basic Electronics I	3
	Total No. of questions:	**07**

Paper-IB **Full Marks-50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of Questions

Unit	Topics	No. of questions to be set
I	Diode and transistor circuits	4
II	OP-AMP and OP-AMP Circuits	3
	Total No. of Questions:	**07**

Part-II Examination **Full Marks: 200**

Paper-IIA **Full Marks: 50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of questions

Unit	Topics	No. of questions to be set
I	Digital Electronics	4
II	Instrumentation	3
	Total No. of Questions:	**07**

Paper-IIB **Full Marks-50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which 5 questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered taking two from each unit.

Setting of questions

Unit	Topics	No. of questions to be set
I	Electromagnetism and transmission lines	4
II	Wave guides, modulation, noise and radiowave propagation	3
	Total No. of Questions:	**07**

Paper-III A : Practical **Full Marks: 50**

Electricity and Analog Electronics (one experiment to be performed).

Marks distribution: LNB-05, Viva-10, Exprt.-35

Paper-III B : Practical **Full Marks: 50**

Digital Electronics (one experiment to be performed).

Marks distribution: LNB-05, Viva-10, Expt.-35

Part-III Examination **Full Marks: 100**

Paper-IVA **Full Marks: 50**

Q. No. 1 is compulsory and it will contain 8 short questions of 2 marks each, out of which five questions to be answered (2x5=10).

Four long questions of 10 marks each to be answered at least one from each unit.

Setting of questions

Unit	Topics	No. of questions to be set
I	8085 microprocessor	4
II	Computer programming	3
	Total no. of questions:	**7**

Paper-IVB: Practical **Full Marks: 50**

Group A: **Full Marks: 30**

Assembly language programming (one experiment to be performed).

Marks distribution: LNB-04, Viva-6, Expt.-20

Group B: **Full Marks: 20**

C Programming (one experiment to be performed)

Marks distribution: LNB-03, Viva-05, Expt.-12

GENERAL SYLLABUS

Part I Full marks 150

Module I Full Marks 50

Paper IA: Introduction to Electric circuits and Basic Electronics I Marks-50

Total no. of lecture periods: 55

I. Introduction to Electric Circuits

Lecture periods: 30

Electric Circuit Elements: Resistance and resistors, types of resistors, resistor colour coding, variable resistors (pots and resistance boxes), power rating of resistors, capacitance and capacitors, types of capacitors, voltage rating of capacitors, capacitor coding, self-inductance and inductor coils, air-core and iron-core coils, mutual-inductance and transformers, autotransformer, transformer ratings, variable inductance. (12)

Kirchoff's Laws and Network Theorems: Kirchoff's current and voltage laws, branch-current, mesh-current and node voltage methods of circuit analysis, T to Pi and Pi to T conversions, Thevenin, Norton, Maximum Power Transfer and Superposition theorems (proofs not required) and applications to simple problems. **(**8**)**

Transient analysis: Theory of charging and discharging a capacitor through a resistance. (2)

Forced oscillations and resonance: Theory of forced oscillations in a series LCR circuit, series resonance in an acceptor circuit, Q factor, parallel resonance in a rejector circuit. (8)

Text and/or Reference Books:

Electricity and Magnetism, Yearwood
Network Analysis, D.Roychowdhury, New Age
Circuits and Networks, Sudhakar Shyammohan, Tata McGraw Hill

II. Basic Electronics I: Semiconductors and Analog Electronic Devices

Lecture periods :25

Physics of Semiconductors: Classification of crystals into insulators, metals and semiconductors using energy band theory, intrinsic and extrinsic semiconductors, p and n type semiconductors, mechanism of current conduction in semiconductors (drift and diffusion), mobility, current density and conductivity, Hall effect. (5)

p-n junction and the semiconductor diode: Potentials and fields across a p-n junction, energy band diagram, the p-n diode, Volt-ampere (V-I) characteristic of a forward and reverse biased p-n junction diode, difference in characteristics among Si, Ge and GaAs diodes, Shockley's equation, temperature dependence of V-I characteristics, V-I characteristics of a reverse biased Zener diode. (5)

Bipolar Junction Transistor (BJT): pnp and npn transistors in Common Base (CB) , Common Emitter (CE) and Common Collector (CC) modes, current components in a BJT, current gains: α and β, input, output and static characteristics in CB and CE modes. (6)

Field Effect Transistor (FET): Construction of a Junction Field Effect Transistor (JFET), n-channel and p-channel JFETs, drain characteristics and transfer characteristics of an n-channel JFET, construction of a Metal Oxide Semiconductor Field Effect Transistor (MOSFET), n-channel and p-channel, depletion and enhancement type MOSFETs, drain and transfer characteristics of n channel depletion MOSFET, FET parameters. (9)

Text and/or Reference Books:

Foundations of Electronics, Chattopadhyay and Rakshit , New Age
Basic Electronics, Theraja S. Chand
Electronic Devices and Circuit Theory , R. L. Boylestad and L. Nashelsky, Pearson Education.
Basic Electronics and Linear Circuits , N. N. Bhargava et. Al., TMH
Analog and Digital Electronics, Taraprasad Chattopadhyay, CBS Pub and Distributors
Basic Electronics , K.K.Ghosh, Platinum Publisher

Module II **Full Marks 100**

Paper IB: Basic Electronics II: Analog Electronic Circuits **Full Marks 50**

Total no. of lecture period: 50

I. Diode and Transistor circuits.

Lecture periods:30

Diode circuits: Diode as a circuit element, half and full-wave rectifier, PIV rating, Bridge rectifier, Effect of filters, load and line regulation with a zener diode. (5)

Transistor biasing: Operating point and the need for biasing, Fixed bias and self-bias. (4)

Small signal low frequency transistor amplifier: Two-port devices and Hybrid-model of a transistor, h-parameters and their determination from the static characteristics, analysis of small signal low frequency amplifier using h-parameters (calculation of current gain, voltage gain, input impedance and output impedance). (8)

Power amplifiers: Class A, B and C large-signal amplifiers. (4)

Feedback in amplifiers: General theory of feedback, negative and positive feedback, advantages of negative feedback, types of negative feedback. (5)

Oscillators: Barkhausen criterion for oscillation, Hartley oscillator, Phase-shift-oscillator, crystal oscillator. (4)

Text and/or Reference Books:

Integrated Electronics, Millman and Halkias , TMH
Foundations of Electronics , Chattopadhyay and Rakshit , New Age

Basic Electronics, Theraja, S. Chand
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson Education.
Analog and Digital Electronics, Taraprasad Chattopadhyay, CBS Pub and Distributors
Basic Electronics , K.K.Ghosh, Platinum Publisher

II. Operational Amplifier (Op-Amp) and Op-Amp circuits

Lecture periods: 20

The 741 Op-Amp: Ideal and practical characteristics of the 741 Op-amp: open loop voltage gain, unity-gain frequency, input resistance, output resistance, input bias current, input offset current, input offset voltage, common-mode rejection ratio; Frequency effect, Slew-rate. (10)

Op-amp circuits: Inverting amplifier, concept of virtual ground, adder, non-inverting amplifier, concept of virtual short, unity gain buffer, phase-shifter, differential amplifier, differentiator, integrator, first order low pass and high pass active filter, D/A converter (Binary-weighted) , comparator, Schmitt-trigger. (10)

Text and/or Reference Books:

Foundations of Electronics , Chattopadhyay and Rakshit, New Age
OP-Amp and Linear Integrated circuits, Gaykwad, Pearson
OP-Amp and Linear Integrated circuits, Coughlin and Driscoll, PHI
OP-Amp and LinearIntegrated Circuits,Roychodhury and Jain , New Age

Part II Full marks 200

Module I Full Marks 50

Paper IIA : Digital Electronics and Instrumentation **Marks 50**

Total lecture periods: 60

I. Digital Electronics Lecture Periods : 35

Number Systems: Decimal, binary, hexadecimal, octal and BCD number systems and conversion from one system to another. (4)

Boolean Algebra: Postulates and theorems, Sum of products and products of sum forms of a Boolean function. (4)

Logic Gates: OR, AND, NOT, NOR, NAND and Ex-OR and Ex-NOR gates, implementation of OR, AND and NOT gates with discrete components, NOR and NAND as universal gates, use of Boolean algebra to describe operation of logic gates. (5)

Digital Integrated Circuits and Logic Families: Digital integrated circuits, levels of integration, characteristics of logic families: Fan-out, Power dissipation, Propagation delay, Noise margin, basic features of Diode Transistor Logic (DTL), Transistor-Transistor Logic (TTL), Emitter-Coupled Logic (ECL) and Complementary MOSFET Logic (CMOS). (8)

Combinational Logic Circuits: Half and Full adders, comparator, multiplexer, decoder and demultiplexer.

(6)

Flip flops and Sequential Circuits: R-S latches, S-R flip flop, D-flip-flop, J-K flip-flop, race condition, Master-slave J-K Flip-flop, asynchronous counter (ripple counter), synchronous counter, Ring-counter, Mod-N counter, shift-registers, ROM and RAM. (8)

Text and/or Reference Books:

Digital Circuits (Vol-I&II), D.RoyChaudhuri, Platinum Publisher
Digital Logic and Computer Design, Mano , Pearson
Digital computer electronics, Malvino and Brown, Tata McGraw Hill

II. Instrumentation: Lecture Periods :25

Regulated Power Supply: Construction of a power supply with rectifier, filter, zener or IC regulator, short circuit protection, positive and negative supplies. (5)

Cathode ray oscilloscope: Block diagram of CRO, cathode ray tube (CRT), construction, basic principles of focusing and deflection of electron beam, basic elements of a CRO, CRO probes, trigger circuits, applications of CRO in measuring voltage, frequency, phase, brief ideas on dual-beam, dual trace and storage oscilloscopes.

(8)

Meters: DC ammeters, voltmeters, voltmeter sensitivity, ohm meter, ammeter (series, and shunt

types), basic features of analog and digital multimeter (DMM), true RMS ac meter, Q meter, power factor meter, digital voltmeter (DVM) (block diagram, A-D conversion techniques, display). (6)

Signal Generators: Generation of sinusoidal, square wave and triangular waves, Function generator (block diagram), Sweep-frequency generator. (6)

Text and/or Reference Books

Modern Electronic Instrumentation and Measurement Techniques, Helfrik and Cooper, Pearson
Elements of Electronic Instrumentation and Measurement, Carr, Pearson
A course on Electrical and Electronic Measurements and Instrumentations, A.K. Sawhney, Dhanpat Rai & Sons.
Electronic Instrumentation, Kalsi , TMH

Module II Full Marks 100

Paper IIB: Electromagnetism and Electronic Communication Full Marks 50

Total no. of lecture periods:55

Introduction to Electromagnetism:

Electrostatics: Coulomb's Law, discrete charge distribution, continuous charge distribution, electric field and electric potential, electric field and electric potential due to a continuous charge distribution, energy consideration, relation between field and potential, lines of force, flux of electric field and Gauss's law (integral and differential forms), divergence and curl of electric field, Poisson's equation, Laplace's equation, electric dipole, dipole field and potential, conductors, capacitors, energy of a capacitor and energy density in an electric field, dielectrics, polarization density, electric polarizability of atoms, polarization charge density, the relation **D = eE + P,** Gauss's Law in presence of a dielectric, boundary conditions on **D and E** (basic concepts, definitions and simple problems)

(7)

Magnetostatics: Biot – Savart Law, divergence of magnetic induction vector, Ampere's Law, Lorentz force,

Faraday's law of electromagnetic induction, motional EMF, mutual and self inductance. (basic concepts,definitions and simple problems) (3)

Transmission lines: Formulation of transmission line equations in terms of voltage and current and their solutions, characteristic impedance, propagation constant, concept of lossless and lossy lines, reflection coefficient, standing wave and standing-wave ratio, line impedance (formula, its derivation and simple problems), line impedance in terms of reflection coefficient or standing-wave ratio, measurement of characteristic impedance using a short circuited and open circuited line. (11)

Wave-guides: Basic concept of a wave guide, advantages over transmission lines, group and phase velocities inside a wave guide, TE and TM modes, qualitative study of rectangular waveguide, concept of and relation between guide-wavelength, cut-off wavelength and free-space wavelength, concept of dominant mode, field- patterns in transverse and longitudinal cross-sections of a rectangular wave guide in TE_{10} mode, wave-guide couping.

(7)

Analog Modulation: Need for modulation, modulating signal, need for carrier signal, types of modulation.

Amplitude modulation (AM): Mathematical representation, modulation index and percentage modulation, frequency spectrum, sideband frequencies, phasors in AM, bandwidth requirements, power carried by carrier and sidebands, DSB, SSB, VSB, suppressed carrier types of AM (basic idea only). Frequency (FM) and Phase Modulation (PM) : Mathematical representation of FM and PM, maximum frequency deviation, modulation index, bandwidth in FM.

(10)

Tone Modulation: Sampling theorem (PAM, PWM, PPM) (6)

Noise : Thermal, shot and flicker noise, Calculation of noise in linear systems, noise bandwidth, Noise in two-port networks-SNR ratio, Noise figure, Noise temperature, their interrelationship, equivalent noise resistance.

(5)

Radio wave propagation: Characteristics of electromagnetic wave, propagation of radio waves at different frequencies, structure of atmosphere, ground wave, sky-wave, critical frequency and virtual height, maximum usable frequency and skip distance. (6)

Text and/or Reference Books:

Electronic Communication Systems, Kennedy ,TMH

Electronic Communication Systems, Reddy and Coolen , Pearson
Analog Digital Communication , B.P. Lathi

Paper IIIA: Practical (Electricity and Analog Electronics) Full Marks: 50

1.Verification of

a) Thevenin's theorem

b) Norton's theorem

c) Maximum power transfer theorem using a resistive Wheatstone bridge, dc source, dc meters.

2. Study of series resonance in electric circuits:

To study the variation of the voltages across the inductance, capacitance and resistance in a series LCR circuit. To determine the current resonant frequency by noting the frequency at which the voltage across the inductance equals that of the capacitance. To plot the graph of the current amplitude versus frequency of the source and hence determine the current resonant frequency, bandwidth and the quality factor (Q value).

3. Study of p-n junction diode:

a) To draw I-V characteristics for forward-bias and to find the dc and ac resistances of a p-n junction diode.

b) To study ripple-factor of half-wave, full-wave and bridge- rectifier with and without filter (the waveform to be studied in a CRO). Also to study the use of bleeder resistor in a π-type filter.

4.Study of a Zener diode:

a) To study the forward and reverse bias characteristics of a Zener diode, b) To study the load and line regulation of a Zener diode voltage regulator.

5. Study of a BJT:

a) To draw the input and output static characteristics of a pnp and an npn transistor in CB and CE configurations and find the respective hybrid parameters.

b) To study the frequency response of a CE amplifier: (i) the input-output voltage relationship at a fixed frequency of the source (say, 1kHz). (ii) the variation of the voltage gain with frequency at a value of the input voltage for which the input-output voltage relationship is linear. (Design of circuit not required). Use a semi-log graph paper to plot the gain versus frequency curve.

6. Experiments on Op-amp: To use the Op-amp as the inverting, non-inverting, differential amplifier, unity gain buffer, and adder.

*** In the final practical examination, questions may be set by combining different parts of the same or different experiments listed above.**

Reference Books:

1. *Basic Electronics: A Text Lab Manual*, Zbar, TMH
2. *Laboratory Manual for Electronic Devices and Circuits*, Bell, PHI

3. *Advanced Practical Physics Volume 2*, B. Ghosh

Paper IIIB: Practical (Digital Electronics) Full Marks 50

1. To use discrete components (resistors, diodes/transistors) to construct OR, AND, NOT and NAND gates on a breadboard. Verify the respective truth-tables.

2. (a) To verify De Morgan's theorems and other Boolean identities using TTL IC chips.

(b) To show why NAND and NOR gates are called universal gates. (Use only NAND gates or NOR gates to construct AND, OR, NOT, EX-OR and EX-NOR gates)

3. (a) To construct a half adder and full adder using NAND gates.

(b) To construct a full adder using 2 half adders and an OR gate.

4. (a) To design a 4:1 multiplexer using TTL NAND gates.

(b) To construct a 2:4 decoder using TTL NAND gates.

(c) To study the 3:8 decoder chip IC 74138. Show how you can use two 3:8 decoders to design a 4:16 decoder. Verify the truth tables.

5. To construct SR, D and JK flip-flops using TTL NAND gates and verify their truth-tables.

Reference Books:

1. *Basic Electronics: A Text Lab Manual*, Zbar, TMH
2. *Laboratory Manual for Electronic Devices and Circuits*, Bell,
3. *Advanced Practical Physics Volume 2*, B. Ghosh.
4. *Digital Logic and Computer Design,* M. Mano, Pearson
5. *Digital Circuits, Volumes 1 and 2* , D. R. Chowdhury , Platinum Publishers

Part: III Full Marks 100

Module I Full Marks 50

Paper IVA : Introducation to the 8085 Microprocessor and Computer Programming

Total no. of lecture periods: 60

I: Introduction to the 8085 Microprocessor

8085 microprocessor architecture and organization, addressing modes, instruction cycle, machine cycle, timing diagram, instruction set, assembly language programming, simple applications, use of subroutines and stacks, interrupts: maskable and non-maskable. Address/data bus demultiplexing, Generation of control signals (IOR/IOW/MEMR/MEMW). (35)

Text and/or Reference Books:

Microprocessor achitecture with the 8085, R.S.Gaonkar, Penram International
Microprocessors -Interfacing and applications , Renu Singh and B.P.Singh, New Age

II: Computer Programming

Lecture periods: 25

The Personal Computer (PC): Idea of a typical PC configuration, role of motherboard, CPU, RAM, Hard-disk, DVD drive, parallel, serial and USB ports, keyboard and mouse. (10)

Basics of Programming in C: Declaration of variables, data types, operators, loops, arrays and functions, file handling, writing simple C programs. (15)

Text and/or Reference Books:

Progress in ANSI C, Balaguruswamy, TMH
Introduction to Computers, Norton , TMH
Introduction to Computer Science, ITL ESL, Pearson
Computer networking, Rowe and Schuh, Pearson
Data communication and networking, Farouzan , TMH
Numerical Methods, Balagurusamy, TMH
Numerical Methods, Mathews, Pearson
Advanced Engineering Mathematics, Jeffrey, Elsevier
Programming in C, Gottfried, TMH
C programming, Balagurusamy, TMH
Computer concepts and C programming, Gupta, Wiley India
The Spirit of C, Mullish Cooper, Jaico
A Book on C, Kelly and Pohl, Pearson
Mastering C, Benugopal and Prasad, TMH

Module II **Full Marks 50**

Paper IVB: Practical (8085 Assembly Language Programming and C programming)

I: 8085 Assembly Language Programming Marks : 30

1. To add two 8-bit numbers stored in two memory locations and store the result in another memory location. Keep a provision for a carry, which may or may not have been generated.
Hints: (1) To use the command ADD r (r is any general purpose register B,C,D,E,H or L).

(2) To use the command ADD M (M is a pointer to the memory location stored in the H-L register pair).

2. To subtract one 8-bit number from another, the numbers being stored in two memory locations.

Hints: (1) To use the command SUB r (r is any general purpose register B,C,D,E,H or L).

(2)To use the command SUB M (M is a pointer to the memory location stored in the H-L register pair).

5.To add two 16-bit numbers stored in two pairs of consecutive memory locations and store the result in a third pair of consecutive memory locations. Keep a provision for a carry, which may or may not have been generated.

Hint: To use the commands: LHLD xxxx, DAD rp SHLD xxxx for the purpose. (xxxx means the address of a memory location and rp represents a register pair).

4. To multiply two 8-bit numbers stored in two consecutive memory locations and store the result in a third memory location.

1. To use the repeated addition algorithm.
2. To use the shift and add algorithm.

5.Assume that the integers 0,1,2,…….9 are stored in 10 consecutive memory locations. Make the microprocessor fetch the numbers one by one and add them. Store the result in a memory location.

Hint: To use the commands LXI H xxxx, INX H and ADD M.

6. Place an 8-bit number in a memory location. Let the microprocessor fetch the number and after checking, place in the next memory location, 00 H if the number happens to be zero and 01 H if the number happens to be otherwise.

Hint: To use the command ANI xx (xx stands for any 8-bit data).

The above problems are only representative in character. Problems different from the above but similar in nature and complexity may also be set in the final examinations.

References:

1. *8085 Microprocessor*, Gaonkar, Penram International
2. *Microprocessors–Interfacing and applications*, Renu Singh and B.P.Singh, New Age.
3. *Microprocessors and peripherals*, S.P. Chowdhury and Sunetra Chowdhury, Scitech.

II. C programming

Marks : 20

1. To calculate the factorial of an integer M where M is given. Write the program

(a) without using recursion (b) using recursion.

2. To calculate the standard deviation of an array of N numbers which may be read from the keyboard.

3. (a) Given two m x n matrices A and B, calculate A + B and A – B. Read the individual elements from the keyboard.

(b) Given an m x k matrix A and a k x n matrix B, evaluate A*B.

4. To obtain the sum of the first N terms of (a) an A.P. series (b) a G. P. series. Read in the required variables from the keyboard.

Problems other than those listed above but of similar complexity and conforming to the syllabus may also be set in the final examination.

References:

Programming in C, Gotfried, Schaum Series, TMH
C Programming, Balaguruswamy, TMH
Computer Fundamentals and C Programming, Dey and Ghosh, Oxford
A Book on C,Kelly and Pohl, Pearson
Mastering C,Benugopal and Prasad, TMH