I PUC THEORY SYLLABUS IN ELECTRONICS - Comprehensive version

ELECTRONICS–I

Electricity, Electronics (analog & digital) and Electronic Components

(Only S.I units to be followed)

1. INTRODUCTION TO ELECTRONICS	4 Hours
Electronics and its scope: **Development of** vacuum tube devices, semiconductor devices, integrated circuits, microprocessors & microcontrollers. **Applications of electronics** – entertainment, communication, defense, industrial & medical. **Impact of electronics on quality of life**	
2. PRINCIPLES OF ELECTRICITY, NETWORK THEOREMS AND AC PRINCIPLES	21 Hours
Charge, Potential difference, DC and AC:	11 Hours
Charge-positive and negative charges, properties of charges, S.I Unit of charge, Charge of an Electron, Number of electrons in one Coulomb of charge, Electric Current-definition (charge/sec), its unit and direction of current- conventional current and the electronic current. Potential difference and its unit related to electric circuit, Direct current (DC) and Alternating Current (AC)-representation and examples of DC & AC sources. **Ohm's law**-statement & limitations, application to circuits. Resistance and its unit, Electric Power-definition, unit of power, electric energy-definition and Power dissipation in resistors -Power formulae and Energy formula. ($P = VI, P = \frac{V^2}{R}$ $P = I^2R$ & kWh). **Combinations of resistors**-series, parallel-derivations of the expressions, series – parallel - circuits and problems. open and short circuit – Problems.	
D.C Sources and Network theorems (for DC circuits)**:**	7 Hours
Introduction to secondary DC sources like dry cells and other type of batteries, internal resistance of sources, Voltage sources: Definitions, Conversion of voltage source to current source and vice versa.	

Kirchhoff's current law and **Kirchhoff's voltage law,** current and voltage division**,** problems up to two loops on Kirchhoff's laws. **Network theorems**: Thevenin's theorem, statements, respective equivalent circuits for dc networks. Super position theorem, statement, analysis with two voltage sources, Maximum power transfer theorem- statement (no derivation) all theorems with respect to DC circuit. Problems on each theorem.	
A.C principles:	3 Hours
Expression for the instantaneous voltage $v = V_m \sin(\omega t)$ (no derivation), definitions of frequency, time period, peak value, r.m.s value, effective value and average value with reference to sinusoidal waveform. Different types of non sinusoidal waveforms square, triangular and saw tooth- mention only.	
3. MEASURING INSTRUMENTS	4 Hours
Electronic Instruments: Voltmeter (AC/DC), ammeter (AC/DC) & Ohm meter – photograph of each one, symbol & uses of each, with diagrams study front panel details of a typical multimeter and a dual channel oscilloscope, use of oscilloscope for measurement of voltage (AC/DC), time period & frequency, precautions while using electronic instruments.	
Medical electronic Instruments: Electrocardiography (ECG), sphygmomanometer (blood pressure instrument), glucometer, ultrasound scan, pulse oximeter, clinical digital thermometer – use of each one.	
4. PASSIVE ELECTRONIC COMPONENTS	22 Hours
Comparison of passive and active components- Passive and active components, their examples. **Resistors:** resistance of conductor & its unit, specification of resistors, temperature coefficient of resistor, specific resistance, types of resistor **–** fixed and variable, Fixed resistors - carbon composition, metal film & SMD resistor, constructional aspects in brief and applications of resistors. **Wire wound resistor:** Construction, applications.	3 Hours

Variable resistors: Potentiometer – carbon composition type – construction and uses, Preset. Importance of power rating in resistors. **Color coding of resistors (4 bands & 5 bands),** tolerance, and problems.	
Capacitors:	6 Hours
Definition of Capacitance and its unit – Principle of capacitor, factors affecting the capacitance of capacitor, parallel plate capacitor (mention $C = \varepsilon_o A/d$ and $C = \varepsilon_o \varepsilon_r A/d$-no derivation), energy stored in a capacitor $E = \frac{1}{2}CV^2$ (no derivation), dielectric and examples, role of dielectric in capacitor.	
Types of Capacitors – fixed and variable. **Fixed capacitors:** Ceramic, Polystyrene, SMD capacitor and Electrolytic capacitor - construction and applications. variable capacitors like ganged capacitor and trimmer - their applications Importance of voltage rating in capacitors. **Capacitive networks -** derivation of expressions for effective capacitance of capacitors connected in series or in parallel trouble shooting in capacitors - open short, leakage.	
Inductors:	10 Hours
Review of laws of electromagnetic Induction **Definitions of self, mutual inductances and unit of Inductance.** **Inductor -** factors determining the inductance of inductor $\left(L = \frac{\mu N^2 A}{\ell}\right)$ **Energy stored in an inductor** i.e., $E = \frac{1}{2} LI^2$ (no derivation), **Fixed Inductors:** Air core, iron core, ferrite core - construction and applications. Expressions for series and parallel combination of inductors neglecting the mutual inductance (no derivations), choke and relays.	
Transformers: Principle (mutual induction), Turns ratio, voltage ratio and current ratio - relation between them, step up and step down transformers, Centre tapping in transformers, problems**,** applications of transformers, Efficiency in transformers, AF & IF	

transformers, pulse transformer.	
Transducers:	3 Hours
Definition of transducer, pressure transducers - microphone and loud speaker – construction, working and applications, Temperature transducers [Thermistor–Negative Temperature Coefficient (NTC) and Positive Temperature Coefficient (PTC) - only mention], LM 35 temperature sensor, LDR, Applications of temperature transducer.	
5. APPLICATION OF D.C AND A.C TO PASSIVE COMPONENTS	14 Hours
D.C applied to Passive components:	2 Hours
Transient phenomenon, transient period, Charging & discharging of a capacitor in RC circuit - expressions (mention only-no derivations), definition of Time constant, graphical representations for charging & discharging of a capacitor. Growth and decay of current in RL circuit - expressions (no derivations), definition for Time constant, graphical representations for growth and decay of current. Problems on RC & RL circuits.	
A.C applied to Passive components:	12 Hours
Concept of phase and phase difference. **AC applied to resistive circuit:** Phasor representation of voltage and current waveforms. **AC applied to capacitive circuit:** Circuit diagram, Expression for instantaneous current and voltage for a sinusoidal input voltage, Phasor representation of voltage and current, definition of phase, phase difference - Lead and lag concepts. **AC applied to inductive circuit:** Circuit diagram, Expression for instantaneous current and voltage for a sinusoidal input voltage**, Phasor representation of voltage and current**, definition of phase, phase difference - Lead and lag concepts. Resistance, reactance and impedance. Capacitive reactance and inductive reactance-definitions and expressions. **Power in AC circuit:** Power factor, active and reactive power. **Series RLC circuits:** Impedance, impedance equation (mention	

only), variation of impedance with respect to frequency. **Series Resonance** - Condition for resonance, Resonant frequency, Half power frequencies, BW, Quality factor in terms of f_r & BW. **Frequency & phase response of RC circuits:** Brief note on filters and its application. Low pass and high pass filters – frequency response and phase response graph and Cutoff frequency, problems.	
6. SEMICONDUCTORS, DIODES AND APPLICATIONS OF DIODES	26 Hours
Semiconductor theory:	4 Hours
Band theory of solids - valence band, conduction band and the forbidden energy gap, Classification of solids as conductors, semiconductors and insulators on the basis of their conductivity and on the basis of energy band diagrams, examples for each. **Types of semiconductors** - Intrinsic and Extrinsic. **Intrinsic semiconductors:** Definition, lattice structure (two dimensional), concept of holes and electrons (their generation and flow in the bands), effect of temperature, thermal generation and recombination of electrons and holes.	
Extrinsic semiconductors: Definition, doping, doping elements - trivalent and pentavalent, meaning of donor and acceptor impurities. **Types of Extrinsic Semiconductors**: n type and p type, their formation, in each case study of lattice structure (two dimensional).	
pn junction:	4 Hours
Formation of pn junction, diffusion of charge carriers, depletion region - formation of depletion region, barrier width and barrier potential, semiconductor diode. **Forward biased pn junction:** Diagram, Effect on width of the depletion region, resistance and current flow. **Reverse biased pn junction:** Diagram, Effect on width of the depletion region, resistance and concept of leakage current (in germanium and silicon), junction capacitance (during reverse bias)	

and its variation with applied reverse bias voltage, brief note on breakdown mechanisms.	
Junction Diode	8 Hours
Circuit symbol, Diode equation $\left[I = I_O(e^{\frac{V}{\eta V_T}} - 1) \right]$ - Numerical problems need not be discussed. Ideal and practical diodes, Equivalent circuit of a practical diode (barrier potential in series with R_f). **V-I static characteristics -** Circuits to study the forward bias and reverse bias characteristics, characteristic curves, knee voltage, forward bias resistance from characteristic curve. Study of various terms related to diode like PIV and power rating (qualitative), diode approximations, Comparison of Germanium and Silicon diodes. **Wave shaping circuits –** clippers – series positive clippers, series negative clippers, clampers - positive clampers, negative clampers.	
Rectification – Need for rectification, Principles, Half wave rectifier, Full wave rectifier (centre tapped and bridge type): Circuit, working of rectifiers considering transformers at the input, input and output wave forms for the rectifiers. Expression for Load regulation - mention only. Expressions (no derivations) for average output voltage V_{av}, average output current I_{av}, V_{rms} and I_{rms}. Efficiency 'η' (expression - no derivation), Ripple and Ripple factor ϒ (expression- no derivation) for each case, comparison of rectifiers. Concept of negative voltage rectifiers. Problems.	
Filters:	2 Hours
Need for filters, series inductor filter, shunt capacitor filter and Inductive input L type filter, - circuit diagram, working and waveforms for each type, bleeder resistance.	
Special purpose diodes & voltage regulators:	8 Hours
Zener diode: schematic symbol, Zener and avalanche breakdown, V-I characteristics of Zener diode, its application in voltage regulation-study of line and load regulation, Calculation of minimum load resistance required for regulation - problems with constant input & variable input voltage.	

Design of practical regulated power supplies – Design of a rectifier for a given DC voltage, Fixed positive regulated power supply using 7812, Fixed negative regulated power supply using 7912 & Adjustable regulated power supply using LM317. Specifications of DC regulated power supply. Light Emitting Diode (LED) - symbol, construction - type of materials used, working in brief and applications. Varactor diode, IR emitter diode, photo diode, tunnel diode & Schottkey diode - symbol, and applications. Seven segment display: LED display - pin configuration showing the different segments-a, b, c, d, e, f, g and dp. Common Anode and Common Cathode display. Display of digits 0 to 9, use of current limiting resistors for each segment, applications. LCD (Liquid Crystal Display), Comparison of L.E.D displays with L.C.D displays.	
7. BIPOLAR JUNCTION TRANSISTOR	7 Hours
Transistor working-npn (in active mode), Symbols, currents I_B, I_C and I_E, Three basic configurations of transistor – CE, CB and CC. DC current gains α and β and the relationship between them. Input and output characteristics of a transistor in CE configuration. Meaning of cutoff, saturation, and active regions. Photo transistor, Opto-coupler & IR receiver transistor – working in brief, symbol & applications	
8. INTRODUCTION TO DIGITAL ELECTRONICS	18 Hours
Introduction, importance of Digital Electronics, representation of digital and Binary signals, Positive and Negative logic. **Number systems –** Need for the study of various number systems, Decimal number system, and Binary number system – advantage, bit, nibble, byte, memory representation using Bytes, hexadecimal number systems, conversion from one system to another. Binary addition, subtraction, multiplication and division, 1's complement, 2's complement, 1's complement and 2's complement method for subtraction of binary numbers (subtraction of a binary number of smaller value from a number of larger value), sign magnitude binary number.	

Boolean algebra and Logic gates: **Boolean Algebra:** Introduction to Boolean Algebra, Basic Boolean operators (OR, AND and NOT operators), Basic Laws and theorems of Boolean Algebra, De Morgan's theorems and their verification, Boolean identities, Simplification of Boolean expressions, **Basic Logic gates**: OR gate and AND gate: Logic symbol, truth table and realization using diodes, NOT gate - using transistor, logic symbol and truth table**.** (Positive logic is to be dealt in all cases). Construction of logic circuits for logic expressions. DTL - NAND, DTL - NOR gates – working and truth table. **Pulse (clock) generator using 555** - Astable multivibrator - frequency & duty cycle, monostable pulse generator – pulse width.	
9. PRACTICAL ELECTRONIC COMPONENTS, THEIR SPECIFICATIONS AND PCB **[Note: photographs, important specifications, part numbers (wherever possible) of each component to be mentioned]** Components part numbers, data sheet, package Resistors – CFR, MFR, SMD resistor, wire wound resistor, fusible Resistor. Potentiometer & trimmer resistors Capacitors – Mica, ceramic, polystyrene, electrolytic, SMD capacitor, trimmer capacitor Inductors – air core, iron core, ferrite core Electromagnetic relay Transformers – Iron core, ferrite core Diodes – rectifying diodes, diode bridge module, switching diodes, Zener diode, LEDs, seven segment display, LCD display. Transistors – npn & pnp transistors Sensors: speaker, microphone, temperature sensor, thermistor, LDR, IR emitter diode, IR receiver transistor Regulators- Fixed regulator: 78XX series, 79XX series, PCB Design & development	4 Hours
Note: Numerical Problems are to be solved for all the expressions wherever appear in the syllabus.	

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DEPT OF PRE UNIVERSITY EDUCATION
I PUC PRACTICAL SYLLABUS IN ELECTRONICS
Practical Electronics–I

I Demonstration Experiments (5 lab Units = 10 hours)

01. Identification of accessories, meters and equipment used in laboratory.

Instructions and safety.

Precautions while using meters and equipment**.**

Accessories (tools) used in Laboratory:

Soldering gun, soldering stand, solder (lead), nose plier, wire stripper, line tester, tag-board, breadboard, general purpose PCB – show and explain each one.

Meters & equipment:

DC milliammeter, AC milliammeter, DC Voltmeter, AC voltmeter, Digital Multimeter, Variable DC power supply, Fixed DC power supply, Audio signal generator, CRO, - show and explain each one.

02. Identification of Components and their specifications-PART 1.

Importance of part numbers

Types of Cables: Solid, stranded, braided, co-axial, twin lead, ribbon, multi conductor, 2 pin and 3 pin mains power cables – show samples - briefly explain each type – with any one use and any one important specifications for each one - **diagrams to be pasted in the record.**

Connectors: Spade lug, solder tags, crocodile clips, banana pin plug, BTI15 terminal, terminal strip, RCA connector, multiple pin connectors, BNC connector - show samples – briefly explain each type – any one use and any one important specifications for each one **- diagrams to be pasted in the record**

03. Identification of components and their specifications-PART 2

Switches: SPST, SPDT, DPST, DPDT, Rotary switch, Push to ON and Push to OFF switch, slide switch, reed switch, relay, MCB, fuse, fuse holder - show samples – check switch action (continuity and discontinuity using multimeter) Specifications; current and voltage ratings - **diagrams and symbols to be pasted in the record.**

04. Electronic Components and their specifications or part numbers - PART 3:

Resistors (CFR, MFR, SMD, wire wound,), potentiometer, capacitors (non polar, electrolytic), inductor, transformer, diode, diode bridge, Zener diode, LED, IR emitter diode, IR receiver transistor, thermistor, LDR, Microphone and loud speaker - show each components, any two important specifications – **diagrams and symbols to be pasted in the record.**

Manufacturer part number for npn transistor, pnp transistor, integrated circuits, fixed positive regulator, fixed negative regulator, adjustable regulator, show samples – **diagrams, symbols/pin numbers and part numbers to be pasted in the record.**

05. Browse in the internet to

i. Collect information on different types of passive components
ii. Collect and study datasheets of active components.

Note: All the demonstration experiments to be completed **within five Practical sessions**. Students should be informed to write the **demonstration experiments 02 to 04 in their practical record book. Questions are asked for 4 marks from demonstration experiments 02 to 04 in the practical examination.**

II Performance Experiments:

Instruction: Transformers input must be connected with 2 pin mains power cord protected with proper insulation at input side must be provided to the students by the instructor wherever necessary. Check output AC voltage of transformer before giving to students.

Name of the experiment
01. Colour coding of resistors 4 band and 5 bands.
02. Verification of Ohm's law.
03. Verification of Kirchhoff's current law and Kirchhoff's voltage law.
04. Verification of Thevenin's theorem
05. Measurement using Oscilloscope a. V_p, V_{p-p}, V_{rms}, time period, frequency for a sinusoidal wave and b. V_p, time period, frequency for square wave.
06. Series resonance circuit–determination of resonant frequency, Bandwidth and Q factor.
07. Frequency response of RC Low pass filter-determination of cut off frequency.
08. Frequency response of RC High pass filter-determination of cut off frequency.
09. Forward characteristics of Semiconductor diode, determination of forward dynamic resistance.
10. Characteristics of Zener diode.
11. Zener diode as a voltage regulator a. Line regulator. b. Load regulator.
12. To study diode positive clipper and positive clamper circuit.
13. Half wave rectifier - Verification for output dc voltage ($V_{dc} = V_m/\pi$), display of input and output waveforms on C.R.O.
14. Bridge rectifier a. Verification for output dc voltage ($V_{dc} = 2V_m/\pi$), display of input and output waveforms on C.R.O. separately (use single channel at a time) b. Shunt capacitance filter; display of filtered output waveforms on C.R.O.
15. Fixed Regulators: To construct fixed regulators using discrete components.

a. +12V (using 7812) regulator
b. -12V (using 7912) regulator

16. Adjustable Regulator: To construct adjustable positive regulator (1.25V-14V) using LM317 and discrete components.
17. OR gate and NOR gate using discrete components - Verification of truth table using voltage measurements.
18. AND gate and NAND gate using discrete components - Verification of truth table using voltage measurements.
19. Astable Multivibrator using IC 555. Verify for frequency and duty cycle.
20. Transistor Characteristics in CE mode: (a) Input characteristics (b) output characteristics

Important Note:

Any 7 Experiments from experiment **no.1 to 10** and **any 7** experiments from experiment **no. 11 to 20** are compulsory**. Total 14 out of 20** experiments are compulsory from performance experiments.

Scheme of Valuation for practical examination:

Note: Ask any two components identifications with diagram, symbol & specifications from demonstration experiments for 4 marks.

i.	**Practical record**	**…….4 marks.**
ii.	From demo experiments (Demo expt. 02 to 04)	…….4 marks
iii.	Initial write-up. (Circuit diagram, Tabular column, Formulae, Equipment and components used, specimen graph)	…….3 marks.
iv.	Performance (circuit connections, Conducting the experiment)	…….6 marks.
v.	Calculations & graph	…….2 marks.
vi.	Result	…….1 marks.
	Total	**…….20 marks.**

Note: Marks allotted to calculations and/graph can be added to PART IV (performance part) wherever applicable for certain experiments like digital experiments.

Projects:

1. Construction of +6V regulated power supply
2. Control of street light using LDR
3. Burglar alarm using IR sensor
4. Fire alarm using thermistor
5. Speed control of DC motor (5V or 12V) using 555 & transistor
6. To construct (+12V, 0, -12V) dual power supply

Students are informed to do at least one project from the above list or any other electronic project. However, projects are not for evaluation in the practical examination.

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