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UNIVERSITY OF MUMBAI

Syllabus for PET- 2020 Examination

for

Electronics Engineering &

Electronics & Telecommunication Engineering

FACULTY OF SCIENCE & TECHNOLOGY

University of Mumbai

Syllabus for PET- 2020 Examination

Section A: Research Methodology and General Awareness

1.0 **Introduction and Basic Research Concepts**
- 1.1 Research – Definition; Concept of Construct, Postulate, Proposition,Thesis, Hypothesis, Law, Principle. Research methods vs Methodology
- 1.2 Need of Research in Business and Social Sciences
- 1.3 Objectives of Research
- 1.4 Issuesand Problems in Research
- 1.5 Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical

2.0 **Types of Research**
- 2.1 Basic Research
- 2.2 Applied Research
- 2.3 Descriptive Research
- 2.4 Analytical Research
- 2.5 Empirical Research
- 2.6 Qualitative and Quantitative Approaches

3.0 **Research Design and Sample Design**
- 3.1 Research Design – Meaning, Types and Significance
- 3.2 Sample Design–Meaning and Significance Essentials of a good sampling Stages
- 3.3 Sample Design Sampling methods/techniques Sampling Errors

4.0 **Research Methodology**
- 4.1 Meaning of Research Methodology
- 4.2 Stages in Scientific Research Process:
  - a.Identification and Selection of Research Problem
  - b. Formulation of Research Problem
  - c. Review of Literature
  - d. Formulation of Hypothesis
  - e. Formulation of research Design
  - f. Sample Design
  - g. Data Collection
  - h. Data Analysis
  - i. Hypothesis testing and Interpretation of Data
  - j. Preparation of Research Report

5.0 **Formulating Research Problem**
- 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis ofdata, Generalization and Interpretation of analysis

6.0 **Outcome of Research**
- 6.1 Preparation of the report on conclusion reached
- 6.2 Validity Testing & Ethical Issues
- 6.3 Suggestions and Recommendation

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Section B: Subject Domain

(Electronics Engineering/Electronics & Telecommunication Engineering)

Engineering Mathematics (Weightage = 10%)

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.
Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Green's theorem.
Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.
Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.
Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis.
Numerical Methods: Solutions of nonlinear algebraic equations, Single and Multi-step methods for differential equations.

Networks, Signals and Systems

(Weightage = 20%)

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2 port network parameters: driving point and transfer functions; State equations for networks.
Continuous-time & Decrete-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Electronic Devices (Weightage = 10%)

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

Analog Circuits (Weightage = 10%)

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, midfrequency 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.

Digital Circuits (Weightage = 10%)

Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

Control Systems (Weightage = 10%)

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Communications (Weightage = 20%)

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Electromagnetics (Weightage = 10%)

Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, Sparameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

Reference Books:

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley International, 9th Edition, 2011.
2. M. E. Van Valkenberg, Network Analysis, Pearson Edation, 3rd Edition, 2019.
3. Alan V. Oppenheim, Alan S. Willsky, Signals and Systems, Pearson, 2nd Edition, 2013.
4. Jacob Millman, Christos C. Halkias, Satyabrata Jit, Electronics Devices and Circuits, McGraw Hill Education, 4th Edition, 2015.
5. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Tata McGraw Hill, 3rd Edition, 2002.
6. S. Salivahanan, S. Pravin Kumar, Digital Circuits and Design, Vikas Publishing House, 4th Edition, 2012.
7. Norman Nise, Control Systems Engineering, John Wiley & Sons, 6th Edition, 2010.
8. John G. Proakis Masoud Salehi, Communication Systems Engineering, Pearson Education, 2nd Edition, 2001.
9. W. H. Hayt, J.A. Buck, Jaleel M. Akhtar, Engineering Electromagnetics, McGraw Hill Education, 8th Edition, 2017.
