



Re-Accredited 'B++' 2.86 CGPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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તા.૨૬-૦૯-૨૦૨૫નાં No.: GAD/NT/GIA/Emp. Notice/25862/2025 લેબોરેટરી

ટેકનીશીયન (ભૌતિકશાસ્ત્ર) સંવર્ગની સ્પર્ધાત્મક પરીક્ષા સંદર્ભે Detailed અભ્યાસક્રમની અગત્યની સૂચના

લેબોરેટરી ટેકનીશીયન (ભૌતિકશાસ્ત્ર) માટે સંબંધિત વિષય અને તેની ઉપયોગીતા અંગેના પ્રશ્નો:

PART: B

TOTAL MARKS : 120

1. Mathematical Physics: (5 Questions, 5 Marks)

First and second order differential equations: Separable equation, exact equation, linear equation, Bernoulli's equation, Clairaut equation, Homogeneous and inhomogeneous forms, undetermined coefficients method, Variation of parameter method, change of variable method General theory of series solutions of linear differential equation, Legendre's differential equation, Bessel's differential equation, Schrodinger equation for a one dimensional quantum mechanical harmonic oscillator. Associated Legendre's differential equation Graphical approach, dropping small terms and iterating approach, WKB method

2. Electronics: (15 Questions, 15 Marks)

The half-wave rectifier, the transformer, the full-wave rectifier, the bridge rectifier, the choke input filter, the capacitor input filter clippers and limiters, clampers, The Zener diode, the loaded Zener regulator, Bipolar Junction Transistors: The unbiased transistor, the biased transistor, transistor currents the CE connection the base curve, collector curves

Review of Thevenin, Norton and Superposition theorems, Mesh and Node circuit analysis, T-Network analysis, a-Network analysis, conversions between T-Network section and -Network section, Bridged-T network, Scaling and Averaging amplifier, Instrumentation Amplifier, Voltage-to-Current converter with floating and grounded load, Current-to-Voltage converter, Integrator and Differentiator circuit, First order Low pass, High pass, and Band pass filters. Phase shift oscillator, Square wave generator, Triangular wave generator, Saw tooth wave generator.

Standard Gate Assemblies, Arithmetic Functions, Digital Comparator, Parity Checker-Generator, Multiplexer, De-multiplexer, Encoder, Decoder, Digital to Analog Converter, Analog to Digital Converter

3. Solid State Physics and Crystal Growth: (15 Questions, 15 Marks)

Crystal, Single Crystal, Poly Crystals, Amorphous, Importance of Single Crystal, Applications of Single Crystal, Crystal Structure, Crystal Structure determination- Bragg's law. Experimental methods of X-Ray Diffraction, Reciprocal Lattice. Perfect and Imperfect Crystals, Point Imperfection, Concentration of Point Imperfection, Line Imperfections, Berger Vector and Berger circuit, Presence of Dislocations, Energy of a Dislocation, Slip Planes and Slip Directions, Surface Imperfections, Effect of Crystal Imperfections

Crystal growth, Crystal growth techniques, The chemical physics of crystal growth, Crystal growth from solution techniques, vapour growth techniques, How to start crystal growth, Advantages and disadvantages of crystal growth methods, Nucleation, classical theory of nucleation, Gibbs Thomson equation for vapour, Modified Thompson's equation for melt, Gibbs Thomson equation for solution, Energy of formation of a nucleus, Spherical and cylindrical nucleus, Cap shaped and disc shaped nucleus

4. Measurement and Industrial Instrumentation: (15 Questions, 15 Marks)

The Functional elements of an Instrument, Input Output configuration of measuring instruments and instrument systems. Dynamic characteristic: Generalized mathematical model of measurement system. Operational transfer function. Sinusoidal transfer function. Zero, first and second order instruments, frequency, ramp and step responses of first and second order instruments.

Pressure measurement: Dynamics response consideration, Bourdon tube pressure gage. Diaphragm and Bellows gages. Transducer: The variable resistance transducer. The Linear Variable Differential, Transformer (LVDT), Capacitive Transducer, Piezoelectric transducer, Photoelectric effect, Photoconductive transducer, Strain gauge transducer. Digital Displacement transducers, Flow measurement: Introduction, Flow obstructions methods, hot wire and hot film anemometers. Magnetic flowmeters, Laser Doppler anemometer

Introduction: Bio potential, cardiovascular system, Electro Cardiogram (ECG), Blood pressure measuring instruments, Doppler Sonography, Computed Tomography imaging (CT scan, CAT scan), Magnetic Resonance imaging (MRI), Specialized MRI Scans, Biofeedback

5. Thin Film Technology and Non-Destructive Testing: (15 Questions, 15 Marks)

Introduction: Thin and thick films processing and technology, Advantages and applications of thin films. Thin films growth process, Thin film deposition process, Physical vapour deposition (PVD): Thermal evaporations, Sputtering Yield, Sputtering systems: DC diode Sputtering, RF diode Sputtering, Magnetron Sputtering, Ion beam Sputtering, ECR plasma Sputtering, Electron beam evaporation, Pulsed Laser deposition (PLD). Chemical vapour deposition (CVD) process: Decomposition reactions, Reduction reactions, Chemical transport reactions and polymerization. Major advantages of CVD, Spray Pyrolysis and Spin Coating systems.

Introduction: Comparison of destructive and non-destructive test, The basic principles, applications, advantages and limitations of important NDT methods, Visual inspection: Optical aids used for visual inspection: Microscope, Borescope, Endoscope, Flexible fiber-optic Borescope, Telescope, Liquid penetrate testing, Magnetic particle testing. Ultrasonic testing. Acoustic emission testing. Insitu metallographic examination, Statistical method for quality control.

6. Microprocessors and Microcontrollers: (5 Questions, 5 Marks)

Comparing Microprocessors and Microcontrollers, Four bit to thirty-two bit Microcontrollers. Numbering systems and Binary Arithmetic: Positional number systems, Integer binary numbers, Fractional binary numbers, Binary addition and Subtraction, Binary multiplication and Division. Binary Codes: Character code, Numeric code, Packed and unpacked BCD numbers, Gray codes, Error correction and detection codes.

7. Communication: (15 Questions, 15 Marks)

Angle modulation, Concept of instantaneous frequency, generalized concept of angle modulation, Wideband FM (WBFM), Generation of FM waves: Indirect method of Armstrong, Direct generation: Parameter variation method, Phase locked loop, Analysis of phase locked loop, Stereophonic FM broadcasting. Comparisons: Frequency and phase modulation, Frequency and Amplitude modulation, External and internal noise, Noise calculations, Noise figure, Noise temperature.

Comparison of Analog and digital communication systems, Sampling theorem: low pass signals, Pulse amplitude modulation, other forms of pulse modulation, Time division multiplexing, Quantization of signals. Quantization error, Pulse code modulation, PCM system, Non uniform quantization, Compandor, Differential PCM: analysis of DPCM, Signal to noise ratio improvement, Delta modulation, Threshold of coding and overloading, Adaptive Delta modulation and output signal to noise ratio. Digital carrier schemes: Frequency shift keying (FSK): FSK bit rate and Baud, FSK

transmitter and receiver, Bandwidth considerations of FSK, Phase shift keying: Binary PSK transmitter and receiver, Bandwidth considerations of BPSK, M-ary encoding, Differential Phase shift keying (DPSK).

8. Semiconductor Device: (20 Questions, 20 Marks)

Carrier transport phenomena: Mobility, Resistivity and Hall Effect, Recombination process, Phonon spectra, optical thermal and high field properties of semiconductor, basic equation for semiconductor device operation. Basic characteristic of three terminal Thyristor Reverse conducting Thyristors, Light activated Thyristor, DIAC and TRIAC, Uni-Junction Transistor and triggering Thyristor

Depletion region and depletion capacitance, Abrupt and linearly graded junctions, Current-Voltage characteristics, Ideal case- Shockley equation, Generation and recombination. Diffusion capacitance, Junction breakdown, Thermal instability, Tunneling effect, Avalanche multiplication, Terminal function, Metal-Semiconductor Contact, Energy band relation, Schottky effect, Ohmic contact, Heterojunction.

Bipolar transistors, Static characteristic, Microwave transistors, Cutoff frequency, Microwave characterization, Device geometry and performance, Power transistors, switching transistor. Basic static performance parameters, non-ideal effect, Hetro-Bipolar Junction Transistor

Optical absorption: Photon absorption coefficient, Electron-Hall pair generation, Solar cell: PN Junction solar cell, Conversion efficiency and solar concentration, Heterojunction solar cell, amorphous silicon solar cell, Photo-detectors, PIN photodiode, light emitting diode, Laser diode, Electronics and Microelectronics, Classification of Semiconductor Devices. Depletion and Enhancement MOSFET, NMOS, Physical behavior of NMOS, Volt-Ampere Characteristics, Comparison of NMOS, for NMOS, Small Signal model of NMOS, NMOS amplifier with small signal analysis, NMOS as analog Switch, CMOS devices, CMOS small signal model, BIFET-BIMOS and BICMOS circuits.

9. Security: (05 Questions, 05 Marks)

Security Environment, Design Principles of Security, User Authentication, Protection Mechanism: Protection Domain, Access Control List.

10. Unix/Linux Operating System: (05 Questions, 05 Marks)

Development of Unix/Linux, Role of Kernel & Function of Kernel, System Calls, Elementary Shell Programming, Directory Structure, System Administration.

11. Current Trends and Recent Advancements in the Above Fields.: (05 Questions, 05 Marks)