

## 6) ELECTRICAL SCIENCES

6

### i) ELECTRICAL AND ELECTRONICS

#### Syllabus & Model Question Paper

#### Part - B

### i) ELECTRICAL AND ELECTRONICS

1. **DC & AC Machines:** Principle of operation, emf equation of DC Machine, constructional features, classification, generator action, voltage regulation, motor action, characteristics, applications, efficiency, testing of DC machines, starting of DC motors. Principle of operation and constructional features of Induction motor, equivalent circuit, circle diagram of IM, torque equation, starting of IM, speed control, application of single phase IM.

Transformers : single phase & 3 phase transformer, principle of operation, equivalent circuit, vector diagram, efficiency & regulation. Polarity test, OC & SC tests. Predetermination of efficiency & regulation. Power & distribution transformers. All day efficiency, Sumpner's Test.; 3 Phase transformer connections: 3 phase to 6 Phase, Scott connection & open delta, Harmonics.

Auto transformers: construction, application, 3ph autotransformer; Construction & operation of cylindrical rotor & salient pole synchronous generators, Emf Equation harmonics & their minimization; Armature reaction, regulation by emf method, mmf method & ZPF Methods. two reaction theory for salient pole machine. Determination of  $X_d$  &  $X_q$  from slip Test, synchronization, synchronizing with Infinite bus, parallel operation of two alternators, operation on infinite bus, load sharing, effect of change in excitation. Power angle, equation of power in terms of power angle.

Synchronous Motor : Principle of operation, V & Inverted V curves, Synchronous Motor as Synchronous Condenser for pf Improvement, Method of starting, Torque & Torque Angle.

2. **Power Generation, Transmission & Distribution:** Hydal, Thermal & Nuclear power plants, plant factors, terminologies connected with the above plants, Power plant Economics, major equipment in power station, power factor improvement, Substations. MVA calculation, current limiting reactors, Typical transmission & distribution schemes, over head transmission lines. Line parameters: calculation of resistance, inductance & capacitance. Short medium & Long transmission Lines. HVDC Transmission concepts; Insulators: Types, potential distribution in suspension insulators, string efficiency, testing of insulators; Underground cables - types, material used, grading of cables, charging current, testing of cables; AC Distribution system: radial & ring main systems. Switch gear and Protection: Fuses, Circuit breakers, switches, relays, protection schemes.

3. **Power Electronics:** Power semiconductor devices - power diodes, power transistors, power MOSFET, IGBT, their switching characteristics, merits & demerits, their typical applications; Thyristor - Two - transistor analogy, static & dynamic characteristics- turn on & turn off characteristics, gate characteristics. Triggering schemes, snubber circuits, Over current & Over voltage protection; Commutation: Line & forced commutation.

4. **Power System Analysis & Computer Methods In Power Systems:** Representation of power system components: Single line diagrams, per unit concept. Symmetrical 3 phase faults: short circuit currents and selection of circuit breaker; Symmetrical components: Resolution of unbalanced voltages & currents into their symmetrical components. Power in terms of symmetrical components, Positive, negative & Zero sequence networks of power systems; Power systems Stability: Steady state and transient stability. Swing equation, equal-area criteria & its application; Load flow studies, Solution of load flow studies by Gauss Sidal, N.R. method & fast decoupled method, economic operation of power system.

5. Classification of Electric drives heating & power rating of motors, Industrial drives, and electric traction

**PART – B**  
**( ELECTRICAL AND ELCETRONICS ENGINEERING)**  
**SECTION – I OF PART – B**

**Each question carries One Mark**

**20 x 1 = 20 Marks**

- 1) A three phase synchronous motor connected to ac mains is running at full load and unity power factor. If its shaft load is reduced by half, with field current held constant, its new power will be
- a) Unity                      b) leading  
c. lagging                    d. dependent on machine parameters
- 2) Keeping in view cost and overall effectiveness, the following circuit breaker is best suited for capacitor bank switching.
- a) Vacuum                  b) air blast                  c) SF<sub>6</sub>                  d) oil
- 3) In thermal power plants, the pressure in the working fluid cycle is developed by
- a) Condenser              b) Super heater              c) Feed water pump              d) turbine
- 4) The rated voltage of a 3- phase power system is given as
- a) Rms phase voltage              b) Peak phase voltage  
c) Rms line to line voltage              d) Peak line to line voltage
- 5) Which three phase connection can be used in a transformer to introduce a phase difference of 30° between its output and corresponding input time voltages
- a) Star- Star                              b) Star- Delta  
c) Delta- Delta                              d) Delta - Zigzag

**SECTION – II OF PART – B**

**Each question carries two marks**

**10 x 2 = 20 Marks**

- 1) A 800 kV transmission line is having per phase line inductance of 1.1mH / km and per phase line capacitance of 11.68 nF/km. Ignoring the length of the line, its ideal power transfer capability in MW is
- a) 1204 MW                  b) 1504 MW                  c) 2085 MW                  d) 2606 MW
- 2) A 110 kV, single core coaxial, XLPE insulated power cable delivering power at 50 Hz, has a capacitance of 125 nF/km. If the dielectric loss tangent of XLPE is  $2 \times 10^{-4}$  then dielectric power loss in the cable in W/km is
- a) 05.0                  b) 31.7                  c) ) 37.8                  d) 189.0

- 3) Two 3-phase Y -connected alternators are to be paralleled to a set of common bus bars. The armature has a per phase synchronous reactance of 1.7 ohms and negligible armature resistance. The line voltage of the first machine is adjusted to 3300 volts and that of the second machine to 3200 volts. The machine voltages are in phase at the instant they are paralleled. Under this condition the synchronizing current per phase will be
- a) 16.98 A      b) 29.41      c) 33.96      d) 58.82
- 4) At an industrial substation with a 4 MW load, a capacitor of 2 MV AR is installed to maintain the load power factor at 0.97 lagging. If the capacitor goes out of service the load power factor becomes
- a) 0.85 A      b) 1.00 A      c) 0.80 lag A      d) 0.90lag A
- 5) A 8 pole, DC generator has a simplex wave wound armature containing 32 coils of 6 turns each. Its flux per pole is 0.06 Wb. The machine is running at 250 rpm. The induced armature voltage is
- a) 96V      b) 192 V      c) 384 V      d) 768V

## 6) ELECTRICAL SCIENCES

### Syllabus & Model Question paper

#### ✓ii) ELECTRONICS & COMMUNICATION ENGINEERING / TELECOMMUNICATION ENGINEERING

#### PART –B

- 1. VLSI Design and Embedded Systems:** Micro-electronics, MOS and Bi-CMOS circuit design, scaling, sub-system design and layout, testability, Embedded micro-controller, CISC & RISC architecture.
- 2. Signals and Systems, DSP:** Types of Signals and Systems, properties of systems, convolution, correlation, Fourier series and transforms (Discrete Time), Z-transform, DFT and FFT, windowing techniques, analog and digital filter design, IIR, FIR filter design, finite word length effect.
- 3. Analog and Digital Communication and Networking:** AM, FM, PM, digital communication – sampling, digital coding of analog wave forms, ISI, digital modulation techniques – PSK, BPSK, QPSK, MSK, spread spectrum. ISO / OSI model, TCP/IP model, internetworking.
- 4. Antennas and Micro Waves:** Transmission lines, Characteristic impedance, impedance transformation, smith chart, impedance matching, Wave guides, modes in rectangular guides, boundary conditions, cutoff frequencies, dispersion relation.; Antennas: Dipole antennas, antenna arrays, radiation pattern, reciprocity theorem, antenna gain; Passive and active microwave devices, microwave measurement, Radar systems, Radio telemetry.
- 5. Power Electronics:** Diodes, transistors, amplifiers, voltage regulators and power supplies, characteristics of DIAC, TRIAC, MOSFET, IGBT, Thyristors and its control circuits, control rectifiers, commutation techniques, AC voltage controller, DC choppers, close loop control of DC drives.

#### PART – B

#### ( ELECTRONICS AND COMMUNICATION ENGINEERING and TELECOMMUNICATION)

#### SECTION –I OF PART - B

Each question carries One Marks

20 x 1 = 20 Marks

- 1) CISC features provide
  - (a) Precise calculations slower than a RISC
  - (b) Intensive calculations slower than a RISC
  - (c) Both (a) and (b)
  - (d) None of the above
- 2) The system is said to be Causal if it is dependent on
  - (a) Present input
  - (b) Present input and Previous output
  - (c) Future input and previous output
  - (d) Previous output
- 3) In a low level modulation AM system, the amplifier following the modulated stage can be

- (a) linear amplifiers
  - (b) Harmonic generators
  - (c) Class C power amplifiers
  - (d) Class B untuned amplifiers
- 4) Broad banding a microwave transistor RF amplifier is difficult because
- (a) of shunt capacitance loading effect.
  - (b) of series capacitance loading effect.
  - (c) Changes in inductive loading affect terminating impedance
  - (d) Changes in output loading affect input impedance
- 5) IGBT stands for
- (a) Insulated Gate Bipolar Transistor
  - (b) Insulated Gate Base Transistor
  - (c) Integrated Gate Bipolar Transistor
  - (d) None of the above

## SECTION – II OF PART - B

**Each question carries two marks**

**10 x 2 = 20 Marks**

- 1) A FM signal is being broadcast in the 88.108 MHz band having a carrier swing of 125 KHz. The modulation index is
- a) 100%
  - b) 83%
  - c) 67%
  - d) 50%
- 2) If the radiated power of AM transmitter is 10k W, the power in the carrier for modulation index of 0.6 is nearly
- (a) 8.24 kW
  - (b) 8.47 kW
  - (c) 9.26 kW
  - (d) 9.6 kW
- 3) The bit rate of a digital communication system is 34 M bit/s. The modulation scheme is QPSK. The baud rate of the system is
- (a) 68 M bit/s
  - (b) 34 M bit/s
  - (c) 17 M bit/s
  - (d) 8.5 M bit/s
- 4) The average voltage of the full wave rectifier with  $V_m = 5$  Volts.
- (a) 3.1.
  - (b) 1.59
  - (c) 4.5
  - (d) 5
- 5) The output voltage of the step down chopper with input voltage  $V_{in} = 25$  Volts and 50 % duty cycle
- (a) 12.5
  - (b) 25
  - (c) 10
  - (d) 5

## 6) ELECTRICAL SCIENCES

### iii) INSTRUMENTATION TECHNOLOGY

#### Syllabus & Model Question paper

#### Syllabus

#### PART – B

- 1. Measurement Basics and Metrology:** Static and dynamic characteristics of measurement systems. Standards and calibration. Error and uncertainty analysis, statistical analysis of data and curve fitting. Linear and angular measurements; Measurement of straightness, flatness, roundness and roughness.
- 2. Transducers, Mechanical Measurements and industrial instrumentation:** Transducers—elastics, resistive, inductive, capacitive, thermo-electric, piezoelectric, photoelectric, electro-mechanical, electro-chemical, and ultrasonic. Measurement of displacement, velocity (linear and rotational), acceleration, shock, vibration, force, torque, power, strain, stress, pressure, flow, temperature, humidity, viscosity and density, energy storing elements, suspension systems and dampers.
- 3. Advanced control Systems:** Describing function analysis. Introduction to Z Transforms, digital controllers, Design and implementation. Optimal and adaptive control system.
- 4. Computers in process Control :** Process definition feedback control, P/D control, multivariable control, feed forward control, real time programming modeling and simulation from plant automation, industrial control applications, Programmable controllers, Design of sampled data control systems.
- 5. Analytical, Optical and Biomedical Instrumentation:** Principles of spectrometry, UV, visible, IR mass spectrometry, X-ray methods; Nuclear radiation measurements, gas, solid and semi conductor lasers and their characteristics, interferometers, basics of fibre optics, transducers in biomedical applications cardiovascular system measurements, instrumentation for clinical laboratory.
- 6. Signals and Systems, DSP :**Types of Signals and systems, properties of systems, convolution, correlation, Fourier series and transforms (Discrete Time), Z-transform, DFT and FFT, windowing techniques, analog and digital filter design, IIR, FIR filter design, finite word length effect.

## MODEL QUESTIONS

### SECTION – I OF PART (B)

**Each question carries 1 mark.**

- 1) The most suitable metals for balls and rollers of antifriction bearings are
  - a) Chromium steel hardened
  - b) Mild steel
  - c) . Low carbon steel hardened
  - d) High carbon steel hardened ]
- 2) In a mechanical system power dissipating element is
  - a) Mass, spring and dash-pot
  - b) Dash-pot
  - c) Spring and dash-pot
  - d) Mass and dash-pot
- 3) A thermocouple is a
  - a) Active transducer
  - b) Passive transducer
  - c) Both a and b
  - d) None of the above
- 4) Electrons emitted from cathode may give an X-ray of wave length 1 Angstrom. The voltage of x-ray tube is
  - a) 12400V
  - b) 11450V
  - c) 12010V
  - d) 11101V
- 5) The transfer function of the tachometer is of the form
  - a)  $Ks$
  - b)  $K/s$
  - c)  $K/(s+1)$
  - d)  $K/[s(s+1)]$

### SECTION – II OF PART (B)

**Each question carries 2 marks.**

- 1) The open loop transfer function of a feedback control system is  $1/(s+1)^3$ . The gain margin of the system is
  - a) 16
  - b) 8
  - c) 4
  - d) 2
- 2) It is required to set an angle of  $30^\circ$  with a sine bar with its center distance between cylinders equal to 254mm. The height of gauge block required is
  - a) 132mm
  - b) 128mm
  - c) 127mm
  - d) 122mm
- 3) In a glass tube spirit level, a sensitivity of 10s is required for a bubble movement of 2mm. The radius of curvature of the glass tube should be
  - a) 41.2m
  - b) 42.5m
  - c) 40.9m
  - d) 41.6m
- 4) A seismic instrument has a natural frequency of 4hz and a damping ratio of 0.66. If the system is excited by a frequency of 6Hz, the error due to the proximity of excited frequency with natural frequency of the instrument is
  - a) 3.9%
  - b) 4.2%
  - c) 3.2%
  - d) 3.42%
- 5) The patient has a cardiac output of 4lts/min. The mean blood velocity in aorta when the vessel diameter of 30mm is
  - a) 90mm/sec
  - b) 96 mm/sec
  - c) 94.3 mm/sec
  - d) 91.28 mm/sec

## 6) ELECTRICAL SCIENCES

### iv) BIO MEDICAL ENGINEERING & MEDICAL ELECTRONICS

#### **Syllabus & Model Question Paper PART- B**

**1. Bio Medical Instrumentation:** Biomedical transducers & electrodes, Sources of bio-electric potentials, bio-signals:- ECG, EEG, EMG, Defibrillators, Cardiac pacemakers, Implantable pace makers, Respiratory measurements & aids, Blood flow meters, Audiometers.

**2. Principals Of Medical Imaging:** X-ray – methods of Generation, detection Biological effects, Image characteristics. Ultrasound – Generation, detection, diagnostic methods, Image characteristics, Biological Effects. Radionuclide Imaging:- Diagnostic methods, Imaging methods, Characteristics Biological effects. MRI:- Generation, detection of NMR signal, Imaging methods, NMR spectroscopy, Characteristics, Biological effects.

**3. Signals & Systems, DSP:** Types of Signals and Systems, Properties of Systems, Convolution, Correlation, Fourier series and transforms (Discrete Time), Z-transform, DFT and FFT, windowing techniques, analog and digital filter design, IIR, FIR filter Design, finite word length effect.

**4. Bio-Medical Signal Processing:** Digital filters, IIR filters – Smoothing, notch, Derivatives, Sampling, Integer Filters, Data Reduction techniques, Signal averaging, Frequency domain techniques- Fourier transform, Correlation, Convolution power spectrum estimation, ECG QRS detection,- power spectrum of ECG, BP filtering techniques, Different template matching, QRS detection algorithm.

**5. Image Processing:** Sampling, Quantization, some basic transformations, Properties of 2D Fourier transform, FFT, separable Image transforms, enhancement in frequency domain, Color Image processing, Masking from frequency domain specification:- errors free Compression, Lossy Compression, Image Compression standards, edge linking & boundary detection, Thresholding, Region oriented segmentation.

**PART – B**  
**(BIO MEDICAL ENGINEERING and MEDICAL**  
**ELCTRONICS)**  
**SECTION – I OF PART – B**

**Each question carries One Marks**  
**Marks**

**20 x 1 = 20**

- 1) An infinite energy signal with finite average power is called as
  - a) Energy Signal
  - b) Power Signal
  - c) Deterministic Signal
  - d) Stochastic Signal
  
- 2) The ST segment represents the period of ECG
  - a) Just after depolarisation of T-wave
  - b) Just after depolarisation of P-wave
  - c) Just before depolarisation of P-wave
  - d) Just after depolarisation of QRS complex
  
- 3) The term which describes the algebraic difference between the indicated value and the true value of the measurand is called as
  - a) Sensitivity
  - b) Resolution
  - c) Precision
  - d) Accuracy
  
- 4) The exercise test has become an established tool for the diagnosis of
  - a) Hypertension
  - b) Mitral valve defect
  - c) Aortic valve defect
  - d) Coronary artery diseases
  
- 5) The film badge readings in the form of maximum permissible dosage is expressed
  - a) Grays
  - b) Rads
  - c) Siverts
  - d) Rems

**SECTION – II OF PART – B**

**Each question carries two marks**  
**Marks**

**10 x 2 = 20**

- 1) If the sampling frequency is 180 Hz located zero at  $120^\circ$  what frequency it eliminates
    - a) 120 Hz
    - b) 30 Hz
    - c) 60 Hz
    - d) 180 Hz
  
  - 2) If the X-ray machine is working on 100 kilovolt p-p, then what is wavelength of the produced X-rays
    - a)  $10 \text{ \AA}$
    - b)  $0.124 \text{ \AA}$
    - c)  $0.5 \text{ \AA}$
    - d)  $1 \text{ \AA}$
- c)  $0.5 \text{ \AA}$

- 3) If the heart rate is 72 bpm with the stroke volume of 70 ml then cardiac output will be  
a) 4.5 ltrs /min      b) 5 ltrs /min    c) 5.5 ltrs /min      d) 700 ltrs /min
- 4) In a DC defibrillator a 16  $\mu\text{f}$  capacitor is charged with a potential of 7000 volts then the estimated output energy is  
a) 350J      b) 400J      c) 500J      d) 700J
- 5) For a signal  $X(t) = 3\cos 50\pi t + 10\sin 300\pi t - \cos 100\pi t$  the nyquist rate is  
a)  $F_N = 30 \text{ Hz}$     b)  $F_N = 300 \text{ Hz}$       c)  $F_N = 100 \text{ Hz}$       d)  $F_N = 50 \text{ Hz}$