

## TS ECET-2019

### SYLLABUS FOR ELECTRICAL & ELECTRONICS ENGINEERING

#### MATHEMATICS (50 Marks)

##### Unit-I: Matrices

Matrices: Definition of Matrix, Types of matrices-Algebra of matrices-Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix-Properties-Laplace's expansion-singular and non singular matrices - Adjoint and multiplicative inverse of a square matrix-System of linear equations in 3 variables-Solutions by Cramer's rule, Matrix inversion method-Gauss-Jordan method.

Partial Fractions: Resolving a given rational function into partial fractions.

Logarithms: Definition of logarithm and its properties, meaning of 'e' exponential function and logarithmic function.

##### Unit-II: Trigonometry

Properties of Trigonometric functions- Ratios of Compound angles, multiple angles, submultiple angles - Transformations of Products into sum or difference and vice versa- Simple trigonometric equations-Properties of triangles-Inverse Trigonometric functions, Hyperbolic functions.

Complex Numbers: Properties of Modulus, amplitude and conjugate of complex numbers, arithmetic operations on complex numbers-Modulus-Amplitude form (Polar form) - Euler form (exponential form)-Properties.

##### Unit-III: Analytical Geometry

Straight Lines-different forms of Straight Lines, distance of a point from a line, acute angle between two lines, intersection of two non-parallel lines and distance between two parallel lines. Circles-Equation of circle given center and radius, given ends of diameter-General equation-finding center and radius, center and a point on the circumference, 3 non-collinear points, center and tangent, equation of tangent and normal at a point on the circle.

##### Unit-IV: Differentiation and its Applications

Functions and limits - Standard limits - Differentiation from the First Principles - Differentiation of sum, product, quotient of functions, function of function, trigonometric, inverse trigonometric, exponential, logarithmic, Hyperbolic functions, implicit, explicit and parametric functions-Derivative of a function with respect to another function-Second order derivatives - Geometrical applications of the derivative(angle between curves, tangent and normal)-Increasing and decreasing functions-Maxima and Minima(single variable functions) using second order derivative only - Partial Differentiation-Partial derivatives up to second order-Euler's theorem.

##### Unit-V: Integration and its Applications

Indefinite Integral - Standard forms - Integration by decomposition of the integrand, integration of trigonometric, algebraic, exponential, logarithmic and Hyperbolic functions-Integration by substitution -Integration of reducible and irreducible quadratic factors - Integration by parts- Definite Integrals and properties, Definite Integral as the limit of a sum -

Application of Integration to find areas under plane curves and volumes of Solids of revolution— Mean and RMS value, Trapezoidal rule and Simpson's 1/3 Rule for approximation integrals.

### **Unit–VI: Differential Equations**

Definition of a differential equation-order and degree of a differential equation- formation of differential equations-solution of differential equation of the type first order, first degree, variable-separable, homogeneous equations, exact, linear differential equation of the form  $dy/dx+Py=Q$ , Bernoulli's equation, nth order linear differential equation with constant coefficients both homogeneous and nonhomogeneous and finding the Particular Integrals for the functions  $e^{ax}$ ,  $x^m$ ,  $\sin ax$ ,  $\cos ax$  or a polynomial of m-th degree( $m=1,2$ ).

### **Unit–VII: Laplace Transforms**

Laplace Transforms (LT) of elementary functions-Linearity property, first shifting property, change of scale property multiplication and division by t - LT of derivatives and integrals, Unit step function, LT of unit step function, second shifting property, evaluation of improper integrals, Inverse Laplace transform (ILT) - shifting theorem, change of scale property, multiplication and division by p, ILT by using partial fractions and convolution theorem. Applications of LT to solve ordinary differential equations to solve ordinary differential equations up to second order only.

### **Unit–VIII: Fourier Series**

Define Fourier series, Euler's formulae over the interval  $(C, C+2\pi)$  for determining the Fourier coefficients. Fourier series of simple functions in  $(0, 2\pi)$  and  $(-\pi, \pi)$ . Fourier series for even and odd functions in the interval  $(-\pi, \pi)$ .

## **PHYSICS (25Marks)**

### **Unit-I: Units and dimensions:**

Physical quantity-fundamental and derived physical quantities-units-fundamental and derived units-SI units-multiples and sub-multiples in SI units-advantages of SI units-dimensions and dimensional formulae-dimensionless quantities- applications and limitations of dimensional analysis-problems.

### **Unit-II: Elements of vectors:**

Scalar and vector quantities-examples-types of vectors-addition and subtraction of vectors-triangle law-parallellogram law-polygon law-resolution of a vector-unit vectors(i,j,k)-dot product and cross product of two vectors- characteristics of dot and cross products-examples- problems.

### **Unit-III: Kinematics and Friction**

Equations of motion-acceleration due to gravity-equations of motion under gravity- projectile motion-examples-horizontal and oblique projections-expressions for maximum height, time of ascent, time of flight, horizontal range, problems. Friction- causes and types of friction-normal reaction-laws of friction-coefficients of friction-angle of friction-methods of reducing friction-

advantages and disadvantages of friction-motion of a body over a rough horizontal surface-problems.

#### **Unit-IV: Work, Power and Energy**

Work, power and energy-definitions and units-potential and kinetic energies-examples and expressions-work-energy theorem – law of conservation of energy-problems.

#### **Unit-V: Simple harmonic motion and Sound**

Definition-conditions of SHM - examples of SHM - expressions for displacement, velocity, acceleration, time period, frequency and phase of SHM-time period of a simple pendulum-seconds pendulum-problems. Sound-musical sound and noise-noise pollution-Effects and methods of control of Noise Pollution-Beats and echo's-problems-Doppler effect– Explanation, and Applications --Reverberation-Sabine's formula-characteristics of a good building-problems.

#### **Unit-VI: Heat and Thermodynamics**

Expansion of gases-Boyle's law-Absolute scale of temperature-Charles laws-Ideal gas equation-Universal gas constant and its value-SI Units-problems-- isothermal process-adiabatic process-first law of thermodynamics - two specific heats of a gas-relation between  $C_p$  and  $C_v$ -problems-second law of thermodynamics.

#### **Unit-VII: Modern physics**

Photo electric effect-explanation and its laws-applications of photo electric effect(photocell)-Einstein's photoelectric equation-critical angle and total internal reflection– optical fibers - principle, working, types and applications-concept of super conductivity – and applications.

### **CHEMISTRY (25 Marks)**

#### **Unit I: Fundamentals of Chemistry:**

**Atomic structure:** Introduction-Fundamental particles – Bohr's theory – Quantum numbers – Aufbau's principle – Hund's rule – Pauli's exclusion principle- Electronic configurations of elements up to atomic number 30, shapes of **s**, **p**, **d** orbital's.

**Chemical Bonding:** Introduction – types of chemical bonds – Ionic bond taking example of NaCl and MgO –characteristics of ionic compounds and covalent bond taking example  $H_2$ ,  $O_2$ ,  $N_2$ , HCl, characteristics of covalent compounds-Coordinate covalent bond.

**Oxidation-Reductions:** concepts of Oxidation-Reduction, Oxidation number and its calculations, differences between oxidation number and Valency.

#### **Unit-II: Solutions:**

Introduction classification of solutions, solute, solvent, concentration, mole concept–Molarity – Normality, equivalent weight using acids, bases and salts, numerical problems on Molarity and Normality.

### **Unit-III: Acids and Bases:**

Introduction – theories of acids and bases – Arrhenius, Bronsted – Lowry theory – Lewis acid base theory – Ionic product of water - pH and related numerical problems – buffers solutions – Applications.

### **Unit – IV: Principles of Metallurgy:**

Characteristics of metals and distinction between metals and non-metals. Definitions of metallurgy, ore, gangue, flux, slag–concentration of ore-hand picking, levigation, froth floatation – extraction of crude metal – roasting calcination, smelting – alloys – composition and uses of brass, German silver and nichrome.

### **Unit-V: Electrochemistry:**

Conductors, insulators, electrolytes - Arrhenius theory of electrolytic dissociation – electrolysis – Faraday’s laws of electrolysis- numerical problems – Galvanic cell – standard electrode potential – electro chemical series –emf and numerical problems on emf of a cell.

### **Unit –VI: Corrosion:**

Introduction – factors influencing corrosion - electrochemical theory of corrosion-composition cell, stress cell and concentration cells - rusting of iron and its mechanism – prevention of corrosion by (a) coating methods, (b) cathodic protection (sacrificial and impressive voltage methods).

### **Unit-VII: Water Technology:**

Introduction – soft and hard water – causes of hardness – types of hardness –disadvantages of hard water – degree of hardness, units and Numerical problems– softening methods – permutit process – ion exchange process – qualities of drinking water – municipal treatment of water for drinking purpose - Osmosis and reverse Osmosis, advantages of reverse Osmosis.

### **Unit-VIII: Polymers:**

Introduction – polymerization – types of polymerization – addition, condensation polymerization with examples – plastics – types of plastics – advantages of plastics over traditional materials – Disadvantages of using plastics, thermo plastics and thermo setting plastics– differences between thermo plastics and thermo setting plastics- preparation and uses of the following plastics: 1. Polythene, 2. PVC, 3. Teflon, 4. Polystyrene, 5.Urea formaldehyde – Rubber – natural rubber – processing from latex –Vulcanization – Elastomers – Butyle rubber Buna-s, Neoprene rubber and their uses.

### **Unit-IX: Fuels:**

Definition and classification of fuels based on physical state and occurrence – characteristics of good fuel - composition and uses of gaseous fuels. (a) Water gas, (b) producer gas, (c) natural gas, (d) coal gas, (e) bio gas, (f) acetylene.

### **Unit-X: Environmental Chemistry:**

Introduction – environment – understand the terms lithosphere, hydrosphere, atmosphere bio sphere, biotic component, energy component pollutant, receptor, sink, particulate, DO, BOD, Threshold limit value, COD- Air pollution - causes-Effects- Forest resources, uses and

over exploitation, deforestation acid rain, green house effect –ozone depletion – control of Air pollution – Water pollution – causes – effects – control measures. Renewable and Non Renewable energy sources – concept of ecosystem – producers, consumers and decomposers – Biodiversity, threats to Biodiversity.

## **ELECTRICAL & ELECTRONICS ENGINEERING (100Marks)**

### **UNIT I:-BASIC ELECTRICAL ENGINEERING**

Ohms and Kirchhoff's Laws, star/delta transformation, Network theorems, work Power and Energy, Heating effects of Electric current, Magnetic effects of Electric current, Electromagnetic Induction, Electrostatics, Types of Electrical Engineering Materials – Conducting, Semi-conducting, Magnetic, Insulating, Di-electric materials –Properties and Uses-Special purpose materials, Batteries, Types, Properties and applications.

### **UNIT II: - D.C. MACHINES AND MEASURING INSTRUMENTS**

D.C. Generators: Construction, Operation, types, EMF Equation, Windings, Armature reaction, Characteristics, Efficiency and Parallel operation, Applications. DC Motors: Principle of operation, Back EMF, Torque Equation, Types, Characteristics, Starters, Speed Control, Losses, Efficiency and Testing. Measuring Instruments: Classification, Deflection, Controlling and damping torques, rs, shunts and multipliers - Construction, Working Principle of Operation of moving Coil, Moving Iron, Dynamometer type, Induction type meters, Errors Instrument Transformers, Induction type Energy meter, Shunts and Multipliers, Measurement of Resistance, Megger, Potentiometer, Transducers and Sensors – Types, Thermistor, Thermocouple, LVDT and Strain gauges. Electronics and digital instruments. Rectifier type, Digital Multimeter, Energy meter, Frequency meter and Clamp meter.

### **UNIT III:A.C. CIRCUITS AND TRANSFORMERS:**

A.C. Circuits: Fundamentals, Series and parallel AC Circuits, Resonant circuits, Polyphase Circuits, Measurement of power by 2 Wattmeter's method. Transformer: Single-phase Transformer, Construction, Operation, Equivalent circuit, regulation, efficiency, Testing and Parallel operation, Accessories of Transformers and Cooling. Three-phase Transformers, Auto-Transformers.

### **UNIT IV: - A.C. MACHINES**

Alternators: Construction, Operation, EMF equation, regulation, testing and parallel Operation. Synchronous Motors: Operation and performance, effects of field excitation, 'V'-Curve and inverted 'V'- Curve, methods of Starting and uses. Hunting and its effects. Three-Phase induction Motors: Construction, Principle of Operation, Torque Equation, Slip- torque characteristics, losses, efficiency, testing, speed control, starters, double-cage motor and applications.

Single-phase Motors: Induction Motor: Types, Principle of operation, applications. Commutator motors: Types, Principle of operation and applications.

## **UNIT V:-POWER SYSTEM GENERATION & PROTECTION**

Generating Stations: Conventional and Non-conventional sources of energy, working, Components, Thermal, Hydel, Nuclear and Gas Power stations, types, Comparison Renewable energy sources, Solar, Photovoltaic and windmill, Pollution control, Combined Working, Power Stations auxiliaries, Characteristic Curves and Important Terms, types of tariffs, power factor correction and economy. Switch gear Power Systems Protection: Circuit Breakers – Types, Principles of operation and uses, Current Limiting, fuses and reactors, Relays – Classification, Principle of Operation of Induction type over current relay, Directional over current relays, distance relays, Protection of alternators, Transformers, Bus-bars, Transmission lines and feeders, Lightning arrestors, neutral grounding.

## **UNIT VI: - TRANSMISSION AND DISTRIBUTION**

Transmission and distribution: Types of supply systems, Transmission line parameters, inductance and capacitance, performance of short and medium lines, regulation, Ferranti effect, Corona, Skin effect, Basic concepts of HVDC Transmission, types, advantages and disadvantages of HVDC Transmission. Components of lines, supports, conductor spacing, ground clearance and sag, insulators, voltage distribution across the string, string efficiency, methods of improving string efficiency. Types of sub-stations and Substation equipment. Cables – Classification, insulation resistance, specifications. Distribution – Radial and ring distributors, variation of load voltage.

## **UNIT VII: - ELECTRIC DRIVES AND TRACTION**

Electric Drives-selection of motors, AC and DC types-rating-load-Equalization – use of fly wheel- types of enclosures and Bearings – reduction of noise. Electric braking – Types – AC & DC – Plugging, Rheostatic and Regenerative braking. Domestic Application and industrial application of Drives. Electric Traction: Systems of Train Electrification, Speed-time Curves for different services, Schedule speed, Tractive Effort, Specific Energy Consumption, Traction system auxiliaries, Traction motor, Supply systems – train lighting systems.

## **UNIT VIII: - ELECTRICAL INSTALLATION AND ESTIMATION**

Electric Wiring: Tools, Wires, Types of wiring, Accessories, Lamp Circuits, Estimating and costing of domestic, industrial, power, irrigation pump sets, over head lines and 11KV Substations, Rural electrification, departmental tests, earthing, maintenance of electrical machines.

## **UNIT IX: - BASIC ELECTRONICS AND DIGITAL ELECTRONICS**

Semi-Conductor devices: Resistance, Color codes, capacitance, specifications, inductance types, PN diode, Zener diode, Characteristics, PNP and NPN Transistors, Transistor configurations, characteristics, half and full wave rectifiers, Bridge rectifiers, Filters, Zener diode regulation. Special devices: UJT, FET, MOSFET, LED, SCR, Opto Coupler, Photo diode, Photo Transistor, CRO and Timers. Amplifiers: Types, Principles of operation, Characteristics, Multistage, Coupled amplifiers, Power amplifiers, and Feedback amplifiers. Oscillators: Types, working principle of operation and applications, CRO and 555 Timer. Digital Electronics: Different numbering systems, inter conversions, Boolean Algebra, Logic families, performance of AND, OR, NOT, NOR, NAND, EX-OR gates, combinational Logic Circuits, sequential logic circuits, Registers and Memories, A/D and D/A converters, counters and flip-flops.

## UNIT X: - POWER ELECTRONICS AND MICRO CONTROLLERS

Power Electronic Devices: Construction and working of SCR, GTO SCR, DIAC, TRIAC, IGBT, LASCR, Volt-ampere characteristics, Triggering of SCR using UJT, Commutation of SCR and SCR Protection. Converters, AC regulators, Choppers, Inverters and Cyclo converters: Types, Characteristics and applications and principle of working. Speed Control of DC/AC motors and application of power devices: Speed control of D.C. Shunt Motors by using converters and choppers, Speed control of Induction motor by using V/F Control and AC voltage regulator, applications. Micro Controllers: Architecture of 8051, instruction set of 8051, programming concepts, applications.

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## TS ECET-2019

### MODEL QUESTIONS FOR ELECTRICAL AND ELECTRONICS ENGINEERING

#### MATHEMATICS

1. If  $\omega$  is a cube root of unity then  $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix} =$   
1) 0                      2) 1                      3) -1                      4) 2
2. If  $\frac{2x+5}{(x+1)^4} = \frac{A}{(x+1)^3} + \frac{B}{(x+1)^4}$  Than (A,B)=  
1) (1,2)                      2) (1,3)                      3) (2,3)                      4) (2,4)
3.  $\tan^{-1}(1/2) + \tan^{-1}(1/3) =$   
1) 0                      2)  $\frac{\pi}{2}$                       3)  $\frac{\pi}{6}$                       4)  $\frac{\pi}{4}$
4.  $\int_0^{\frac{\pi}{2}} \log(\cot x) dx =$   
1) 1                      2) 0                      3)  $2\log 2$                       4) None
5. The differential equation  $\frac{dy}{dx} + \frac{ax+hy+g}{hx+by+f} = 0$  is called  
1) Homogenous                      2) Linear                      3) Exact                      4) None

## PHYSICS

- 1) Dimensional formula for stress
  - 1)  $ML^2T^{-3}$
  - 2)  $ML^{-1}T^{-2}$
  - 3)  $ML^0T^{-2}$
  - 4)  $MLT^{-1}$
- 2) On which principle optical fiber works
  - 1) Reflection
  - 2) Refraction
  - 3) Total internal reflection
  - 4) Total internal refraction
- 3) Relation between centigrade and Kelvin scale of temperature
  - 1)  $T=t+273$
  - 2)  $T=t-273$
  - 3)  $t=T+273$
  - 4)  $t=T-273$
- 4) Find the dot product of two vectors  
 $A=2i+3j+4k$  and  $B=4i-2j+3k$ 
  - 1) 26
  - 2) 14
  - 3) 22
  - 4) 0
- 5) A work done by a man in carrying a load of 60 Kg over his head when he travels a distance of 5m in horizontal direction is ( $g=9.8 \text{ m/s}^2$ )
  - 1) 2940 J
  - 2) 0J
  - 3) 2940m
  - 4) 300J

## CHEMISTRY

1. The Oxidation number of Mn in  $MnO_4^-$  is
  - 1) +5
  - 2) +6
  - 3) +7
  - 4) +4
2. The molarity of 10% NaOH solution is
  - 1) 0.025
  - 2) 0.25
  - 3) 2.5
  - 4) 25
3. Galvanic cells are the cells which convert
  - 1) Electrical energy to chemical energy
  - 2) Chemical energy to electrical energy
  - 3) Chemical energy to Mechanical energy
  - 4) Potential energy to Kinetic energy
4. The exhausted cation exchange resin can be regenerated by using
  - 1) NaCl
  - 2) NaOH
  - 3) HCl
  - 4)  $NH_3$
5. Which of the following is not a Lewis base



- 1) H<sub>2</sub>O      2) BF<sub>3</sub>      3) NH<sub>3</sub>      4) CH<sub>3</sub>OH

## **ELECTRICAL AND ELECTRONICS ENGINEERING**

1. Salient pole synchronous motor is running at no load, its field current is switched off. The motor will
  - 1) Come to stop
  - 2) continue to run at synchronous speed
  - 3) continue to run at speed slightly more than the synchronous speed
  - 4) continue to run at speed slightly less than the synchronous speed
  
2. The generation voltage is usually
  - 1) between 11KV and 33KV
  - 2) between 132KV and 400 KV
  - 3) between 400KV and 700 KV
  - 4) None of the above
  
3. In a transformer the voltage regulation will be zero when it operates at
  - 1) Unity PF
  - 2) Leading PF
  - 3) Lagging PF
  - 4) None of the above
  
4. A 4 pole lap wound DC shunt motor rotates at the speed of 1500 rpm has a flux of 0.4 mwb and the total number of conductors are 1000. What is the value of emf.
  - 1) 100V
  - 2) 0.1V
  - 3) 1V
  - 4) 10V
  
5. Definite maximum time lag relay is also called -----
  - 1) Pilot relay
  - 2) Differential relay
  - 3) over current relay
  - 4) Directional over current relay.