

## SYLLABUS FOR TUEE-2024 AND PROGRAMME CODE

### Undergraduate programme

Sl No	Name of the Programme	Syllabus	TUEE code
1.	B. Des (Bachelor Degree in Design)	<p><b>Visualization and spatial reasoning:</b> Ability to visualise and transform 2D shapes and 3D objects and their spatial relationships.</p> <p><b>Practical and scientific knowledge:</b> Know-how of scientific principles and everyday objects.</p> <p><b>Observation and design sensitivity:</b> The capacity to detect concealed properties in daily life and think critically about them. Attention to detail, classification, analysis, inference and prediction.</p> <p><b>Environment and society:</b> General awareness of environmental, social and cultural connections with design.</p> <p><b>Analytical and logical reasoning:</b> Ability to analyse qualitative and quantitative information.</p> <p><b>Language:</b> Proficiency in reading and comprehending Standard English.</p> <p><b>Creativity:</b> Grasp of verbal and non-verbal analogies, metaphors, signs and symbols.</p>	201

### Lateral Entry to the 2nd year of B.Tech. Programmes

Sl. No.	Branch	Syllabus	TUEE Code
1.	Civil Engineering	<p><b>Mathematics</b> Complex Numbers, Partial fractions, Permutation and combination, Binomial Theorem, Series, Trigonometric Ratios, Properties of Triangle, Volume and Surface Area, Co-ordinate Geometry, Functions, Differentiation, Integration, General aptitude and reasoning.</p> <p><b>Civil Engineering</b> Building Construction &amp; Materials, Civil Engineering Drawing, Surveying, Structural Mechanics, Hydraulics, Concrete Technology, Transportation Engineering, Design of RCC Structure, Geotechnical Engineering, Design of Steel Structure, Environmental Engineering &amp; Pollution Control, Water Resources Engineering</p>	203
2.	Computer Science and Engineering	<ol style="list-style-type: none"> <li>10+2 level Physics and Mathematics</li> <li>C/C++ programming</li> <li>Algorithms and Data Structures</li> <li>Array, stack, queue, linked list, sorting, selection, searching.</li> <li>Basic Electronics and Digital Logic</li> <li>Digital circuits and signals, Logic Families, Logic Gates and Boolean algebra, Number Systems.</li> <li>Computer Networks</li> <li>Basic concepts, Network Classifications, Network topology, OSI model, Basics of TCP/IP.</li> <li>Database Management Systems</li> <li>Basic concepts, ER model, Relational model, Query languages.</li> <li>Communicative English</li> </ol>	204
3.	Electrical Engineering	<p><b>CORE ELECTRICAL</b></p> <ul style="list-style-type: none"> <li>■ <b>DC Circuit Analysis:</b> Electric Circuits Laws: Basic electric circuit terminology, Ohm's law, Kirchoff's current law (KCL) and Kirchoff's Voltage law (KVL), circuit parameters (resistance, Inductance and capacitance), series and parallel combinations of resistance,</li> </ul>	205

		<p>Inductance and capacitance , Nodal analysis. Energy Source, Ideal and Practical voltage and current sources and their transformation, Dependent voltage sources and dependent current sources, D.C. Circuit Analysis, Power and energy relations, Analysis of series and parallel DC circuits, mLoop and Nodal methods of circuit analysis, Superposition theorem, Thevenin's and Norton's theorems, maximum Power theorem, Delta - star (Y) Transformation.</p> <ul style="list-style-type: none"> <li>■ <b>A.C. Circuit Analysis:</b> Basic terminology and definitions, Phasor and complex number representation, solutions of sinusoidally excited RLC circuits, Power and energy relations in A.C. circuits, Applications of network theorems to A.C. circuits, Resonance in series and parallel circuits, Concepts of active &amp; reactive powers.</li> <li>■ <b>Steady State A.C three phases Circuits:</b> Concept of a 3-phase voltage, wye (Y) circuits. Delta (<math>\Delta</math>) circuits, Current and voltage relations in Y and <math>\Delta</math> Circuits, Characteristics of a 3-phase system, Magnetically Coupled circuits, Mutual inductance.</li> <li>■ <b>Single Phase Transformers:</b> Introduction, classification, construction, electromotive force (e. m. f.) equation, Equivalent circuit model, Phasor diagrams, Losses and efficiency, Voltage regulation, Transformer tests (polarity test, open circuit test and short circuit test), Auto-transformers</li> <li>■ <b>Direct current Generators:</b> General introduction, principles of operation of D.C Generators, construction of D.C Generators, Types of DC Generators, e.m.f equation, Types of windings, power stages and efficiency, commutation and armature reaction, characteristics of D.C Generators.</li> <li>■ <b>Direct current Motors:</b> Principles of operation of D.C Motors, construction of D.C Motors, Types of DC Motors, Back e.m.f and Torque equation, torque and speed of D.C Motors, characteristics of various types of D.C motors, speed control of D.C motors.</li> <li>■ <b>Induction Motors:</b> Construction and working principle of 3 phase Induction motors, types of rotors, rotating magnetic field, slip, effect of slip on rotor parameters, torque equation, torque-speed characteristics, effect of rotor resistance on torque-speed characteristics, Single phase induction motors, starting and applications.</li> </ul> <p><b>PHYSICS:</b> Vector Analysis, Collision of particles, Vibration and acoustics, Electromagnetic Theory, Maxwell's equations, Quantum mechanics, Solid state physics, Superconductivity, Diffraction, Special Theory of Relativity.</p> <p><b>MATHEMATICS:</b> Differential Calculus, ordinary, linear and non-linear differential equations, Partial Differential Equations, Fourier series, Matrices.</p>	
4.	Electronics and Communication Engineering	<ol style="list-style-type: none"> <li>1. <b>Materials and Components:</b> Structure and properties of Electrical Engineering materials: Conductors, Semiconductors and Insulators, Magnetic, Ferroelectric, Piezoelectric, Ceramic, Optical and Super conducting materials. Passive components and characteristics Resistors, Capacitors and Inductors; Ferrites, Quartz crystal Ceramic resonators, Electromagnetic and Electromechanical components.</li> <li>2. <b>Physical Electronics Electron Devices and ICs:</b> Electrons and holes in semiconductors, Carrier Statistics, Mechanism of current flow in a semiconductor, working principle and basic structure of BJTs and FETs.</li> <li>3. <b>Network Theory:</b> Network analysis, Loop Analysis, Mesh Analysis; Network Theorems, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Star-Delta Connections, Two port networks.</li> <li>4. <b>Electronic Measurement sand Instrumentation:</b> Basic concepts, standards and error analysis; Measurements of basic electrical quantities and parameters; Electronic measuring instruments and their principles of working; analog and digital, comparison, characteristics, application Transducers; Electronic measurements of non-electrical quantities like temperature, pressure, humidity, etc.</li> <li>5. <b>Analog Electronic Circuits:</b> Transistors biasing and stabilization, small signal analysis, power amplifiers, frequency response, wide banding techniques, feedback amplifiers, Tuned amplifiers, Oscillators, Rectifiers and power supplies, Op Amp.</li> <li>6. <b>Digital Electronic Circuits:</b> Binary number system, Octal,</li> </ol>	206

		<p>Hexadecimal and BCD numbers system, Boolean algebra, simplification of Boolean functions, Karnaugh map and applications, IC logic, Combination logic circuits, Halfadder, Full adder, Digital comparator, Multiplexer, De multiplexer, Flip Flops,R-S,J-K,D and T flip - flops, different types of counters and registers,A/D and D/A converters, semiconductor memories.</p> <p>7. <b>Control Systems:</b> Types of Control system, Open Loop and Closed Loop Control system, Effect of feedback on stability and sensitivity; Block Diagram Reduction Technique, Signal Flow Graph, Stability Analysis, Routh's Stability Criterion.</p> <p>8. <b>Communication System:</b> Basic Mathematical Tools like Fourier Series, Modulation and detection in analogue and digital system; Sampling and data reconstructions; Propagation of signals at HF, VHF, UHF and microwave frequency.</p> <p>9. <b>Computer Engineering:</b> Number system, Data representation Programming; Elements of a high level programming language PASCAL/C, use of basic data structures, Fundamentals of computer architecture, processer design, control unit design, memory organization, I/O system organization, microprocessors, architecture and instruction set of microprocessors 8085, Assembly language programming.</p>	
5.	Mechanical Engineering	<p>1. Engineering Mechanics: Force systems, force, moment of a force about a point and about an axis, couple moment as a free vector, equivalent force systems; Equilibrium, free body diagram, equations of equilibrium, problems in two and three dimensions; Kinematics and Kinetics of particles, particle dynamics in rectangular coordinates and in terms of path variables, Newton's law for rectangular coordinates, Newton's law for path variables, central force motion; Energy, kinetic energy, potential Energy, conservation of energy.</p> <p>2. <b>Solid Mechanics:</b> Introduction, stress at a point, types of stress, strain, shear and normal strain. stress-strain diagram, true stress and true strain, Hooke's law, Poisson's ratio, material properties for isotropic materials and their relations, generalized Hooke's law, stress-strain relationship;Elastic constants, Young's modulus, shear modulus, Poisson's ratio, relationships between elastic constants.</p> <p>3. <b>Machine Design:</b> Static and dynamic loading, threaded joints, riveted joints, welded joints, design of gears, belt drives, brakes, bearings.</p> <p>4. <b>Theory of Machines:</b> Mechanism and machines, flywheel, friction, gears, kinematic analysis. Thermodynamics: Basic definitions, thermodynamic systems and properties, thermodynamic processes and cycles; Different types of work and heat transfer; First law of thermodynamics, internal energy, enthalpy, non-flow and flow processes; steady state, steady flow energy equation(SFEE); Second law of thermodynamics, Kelvin Plank and Clausius statement, irresistibility,Carnot cycle and Carnot's theorem, applications of secondlaw to closed and open systems, heat engine, heat pump and refrigerator, entropy, Clausius theorem, Clausius inequality, entropy principle and its application, entropy generation in closed and open system, absolute entropy; Available energy; Vapour power cycles.</p> <p>5. <b>Heat Transfer:</b> Steady state heat conduction, 1-D heat conduction equations in plane wall, heat generation, conduction through multilayer walls, heat conduction in cylinders and spheres, critical radius of insulation, heat transfer through extended surfaces, fin efficiency; Radiation heat transfer, radiation intensity, emissive power etc., radiation shield, shape factor; Convection heat transfer: introduction to natural and forced convection, internal and external flow, various dimensionless numbers; Heat exchangers: parallel flow, counter flow, cross flow heat exchangers, multipass shell and tube exchangers, phase change heat exchangers, LMTD and NTU methods; Introduction to mass transfer, Fick's law of mass diffusion.</p> <p>6. <b>Fluid Mechanics:</b> Concept of fluid and fluid properties, Newton's Law of viscosity; Fluid Statics, forces on fluid element, different types of pressure and measuring instruments, hydrostatic forces on plane and curved surfaces, buoyancy and stability of submerged and floating bodies; Fluid kinematics, steady, unsteady, uniform and non-uniform flow, laminar and turbulent flow, stream- line, path line, streak line; Equations for conservation of mass, momentum and energy, Euler's</p>	207

		<p>and Bernoulli's equation, measurement of flow through pipes and different flow measuring devices; Dimensional analysis, kinematic and dynamic similarity, various dimensionless numbers; Potential flow, stream function, vorticity, velocity potential, uniform flow, major and minor losses, friction factor; Boundary layer equations, the flat plate boundary layer; Introduction to compressible flow;; Impulse and reaction turbine, Pelton wheel, Francis and Kaplan turbine, Rotodynamic and positive displacement pumps, reciprocating pump, centrifugal pump, specific speed, cavitation.</p> <p>7. <b>IC Engine:</b> Construction and working principle of SI and CI engines, Construction and working principle of four stroke and two stroke engines, theoretical cycles used in IC engines, performance analysis of IC engines.</p> <p>8. <b>Materials Science:</b> Classification and properties of engineering materials, bonds in solids and characteristics of metallic bonding, general classifications, properties and applications of alloy steel, stainless steel, cast iron and non-ferrous materials; Crystal systems and imperfections, crystallography, Miller Indices for directions and planes, voids in crystals, packing density, crystal imperfections, point, line, surface and volume defects; Phase Diagrams and Phase Rules, principles and various types of phase diagrams, Fe- Fe<sub>3</sub>C diagram, TTT and CCT diagrams; Heat treatment in steels, pearlitic, bainitic and martensitic transformations.\</p> <p>9. <b>Manufacturing Technology:</b> Rolling, extrusion, sheet-metal forming, forging, welding, mechanism of metal cutting, machining processes, machinability; Modern machining processes.</p> <p>10. <b>Industrial Engineering:</b> Work study, method study and work measurement; Plant layout, types of production, types of layout, tools and techniques for plant layout; Project scheduling, PERT and CPM; Production control, Gantt chart; Material handling.</p>	
6.	Food Engineering and Technology	<p><b>Part-I: General Engineering: Thermodynamics, Heat &amp; mass transfer, Fluid mechanics (weight age: 40%)</b></p> <p>1. <b>Engineering Thermodynamics:</b> Zeroth law, first law, second law. Concepts of enthalpy, internal energy, entropy and absolute temperature. Properties of pure substances and mixtures, reversibility and irreversibility. Thermodynamics cycles. Refrigeration and air conditioning: Refrigeration cycles, heat pump. Application of refrigeration in food processing and preservation. Food freezing systems. Steam: steam generation, steam properties and application. Psychrometrics: properties of air water vapor mixture; psychrometric properties, charts and relations and psychrometric calculations.</p> <p>2. <b>Heat and Mass Transfer:</b> Principles of heat and mass transfer to heat, different methods of heat transfer, Fourier's Law, Steady state heat transfer through plain and composite slabs, cylindrical and spherical surfaces. Natural and forced convection, concept of overall heat transfer coefficient, LMTD, heat exchangers in food processing, effectiveness of heat exchanger. Fick's Law of diffusion and basic concepts of convective mass transfer.</p> <p>3. <b>Basic Fluid Mechanics:</b> Physical properties of fluids, classification of fluid flow, continuity equations, Bernoulli's equation and its application, steady state flow equation, concept of viscosity, Newtonian and non-Newtonian fluids. Poiseuille's equation. Navier Stoke's equation, flow through parallel plates and circular pipes. Concept of Reynold's number and its application. Pipe and pipe flow, fittings. Pumps, types of pumps and their application and selection.</p> <p><b>Part-II: Food Engineering and Technology (weightage: 60%)</b></p> <p>1. <b>Food Engineering Operations:</b> Materials and introduction energy balance for food engineering processes. Size reduction, mechanical expression, mechanical separation, mixing and agitation, emulsification, and homogenization. Filtration, membrane separation, sedimentation, centrifugation, crystallization, extraction, distillation, absorption, humidification, and dehumidification. Thermal processing of foods, Food concentration: Evaporation, equipment, their selection</p>	208

		<p>and calculation. Freeze concentration. Drying and dehydration methods, different kinds of dryers, their selection and design.</p> <p>2. <b>Food Microbiology:</b> Microbiology and reproduction of bacteria. Pure culture technique: serial dilution, pour plate, streak plate, spread plate, slant, broth and enrichment culture, lyophilization. Microbial Growth: Definition, Growth curve, account of different phases, synchronous growth, doubling/generation time. Relationship between number of generations and total number of microbes. Disinfecting agents and its dynamics. Enzymes, specificity of enzymes, co enzymes, cofactors, Enzymes inhibitors and activators. Applications of enzymes in food industry, immobilized enzymes. Definition, scope and present status of Biotechnology and its applications, Microbial propagation and production of SCP, Fermentation: Fermented and non-Fermented food, cereal fermentation.</p> <p>3. <b>Food Chemistry:</b> Importance of different food constituent, Carbohydrate and its classification and functions. Proteins, classification, and properties of amino acids. Lipid's structure, physical and chemical properties. Vitamins and minerals in food. Food spoilage: Types and factors, Food enzymes. Food preservation techniques: Addition of salt, sugar, oil, spices, preservative, drying, evaporation, heat treatment, irradiation, refrigeration, freezing, plant physiology: Transpiration, Ripening, Senescence, Post-Harvest technology and its importance, Climacteric and non-climacteric fruits.</p> <p>4. <b>Food Product technology:</b> Parboiling, Milling of rice, wheat, malting, storage atmospheres: Quality control and quality assurance, different quality attributes: qualitative, hidden and sensory, HACCP and its application, Food adulteration: types, Estimation of moisture, crude, fat, proteins, crude fibre, ash, sampling and its types, BIS, AGMARK, FPA, PFA, FAO, FSSAI.</p>	
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- Exact number of candidates to be admitted in each discipline will be notified separately on the university webpage after facilitating internal branch sliding among continuing students.

#### M.Tech/MA/MSc Programmes

Sl. No	Department	Name of the Programme	Syllabus	TUEE code
1.	Civil Engineering	M. Tech. in Civil Engineering	B.E/B.Tech. level courses in Civil Engineering	301

2.	Computer Science and Engineering	M. Tech. in Computer Science & Engineering	<ul style="list-style-type: none"> <li>■ <b>Analytical Reasoning.</b></li> <li>■ <b>Data Structures:</b> Array, Stack, Queue, Linked List, Binary Tree, Heap, Graphs, AVL Tree, B-tree.</li> <li>■ <b>Graph Theory:</b> Paths and Cycles, Connected Components, Trees, Digraphs.</li> <li>■ <b>Discrete Mathematics:</b> Sets and Sequences Counting, Logic &amp; Proofs, Recurrence Relations. Algebra of Matrices, Determinant, Eigenvalues and Eigenvectors of Matrices,</li> <li>■ <b>Design and Analysis of Algorithms:</b> Asymptotic Notation, Searching, Sorting, Selection, Graph Traversal, Minimum Spanning Tree.</li> <li>■ <b>Formal Languages and Automata Theory:</b> Finite Automata and Regular Expressions, Pushdown Automata, Context-free Grammar, Turing Machine, Elements of Undecidability.</li> <li>■ <b>Digital Logic Design:</b> Boolean Algebra, Minimization of Boolean Functions, Combinational and Sequential Circuits - Synthesis and Design.</li> <li>■ <b>Computer Organization and Architecture:</b> Number Representation, Computer Arithmetic, Memory Organization, I/O Organization.</li> <li>■ <b>Operating Systems:</b> Memory Management, Processor Management, Device Management, File Systems.</li> <li>■ <b>Database Management Systems:</b> Relational Model, Relational Algebra, Relational Calculus, Functional Dependency, Normalisation (2NF, 3NF and BCNF).</li> <li>■ <b>Principles of programming:</b> types of programming languages, language, processors, program linking, program memory allocation, code optimization.</li> <li>■ <b>Computer Networks:</b> OSI, LAN Technology - Bus / Tree, Ring, Star; MAC Protocols; WAN Technology - Circuit Switching, Packet Switching; Data Communications - Data Encoding, Routing, Flow Control, Error Detection/ Correction, Inter-networking, TCP/IP Networking including IPv4.</li> </ul>	302
3.		M. Tech. in Data Science	<ul style="list-style-type: none"> <li>■ Analytical Reasoning</li> <li>■ Discrete Mathematics: Permutations and Combinations, Recurrence Relations. Algebra of Matrices, Determinant, Rank and Inverse of a Matrix, Functions and Relations.</li> <li>■ Discrete Probability Theory: Combinatorial Probability, Conditional Probability, and Bayes Theorem. Discrete Random Variables. Expectation and Variance of Discrete Random Variables.</li> <li>■ Graph Theory: Graphs, Adjacency Matrix and Adjacency List representations of Graphs, Subgraphs, Connectivity, Trees and their Properties, Vertex Coloring, Planar Graphs.</li> <li>■ Algorithmic Thinking: Asymptotic Notations, Searching, Sorting, Selection, Graph Traversal, Minimum Spanning Tree.</li> <li>■ Basic Programming Concepts using C/C++</li> <li>■ Data Structures: Array, Stack, Queue, Linked List, Binary Tree, Heap, AVL Tree, B-tree.</li> <li>■ Computer Organization and Architecture: Number Representation, Computer Arithmetic, Instruction Set Architecture, Memory Organization, I/O Organization,</li> <li>■ Operating Systems: Memory Management, Processor Management, Device Management, File Systems.</li> <li>■ Database Management Systems: Relational Model, SQL, Functional Dependency, Normalisation (2NF, 3NF and BCNF).</li> <li>■ Computer Networks: OSI, LAN Technology, MAC Protocols, WAN Technology - Circuit Switching, Packet Switching, Routing, Flow Control, Inter-networking, TCP/IP Networking including IPv4.</li> </ul>	303

4.		Master of Computer Application (MCA)	Logical Reasoning, Basic Mathematical Ability, Fundamentals of Computer Science, Fundamental programming concepts, English Vocabulary and composition.	304
5.	Design	Master of Design# (M.Des.)*	<p><b>Visualization and spatial reasoning:</b> Ability to visualise and transform 2D shapes and 3D objects and their spatial relationships.</p> <p><b>Practical and scientific knowledge:</b> Know-how of scientific principles and everyday objects.</p> <p><b>Observation and design sensitivity:</b> The capacity to detect concealed properties in daily life and think critically about them. Attention to detail, classification, analysis, inference, and prediction.</p> <p><b>Environment and society:</b> General awareness of environmental, social and cultural connections with design.</p> <p><b>Analytical and logical reasoning:</b> Ability to analyse qualitative and quantitative information.</p> <p><b>Language:</b> Proficiency in reading and comprehending Standard English.</p> <p><b>Creativity:</b> Grasp of verbal and non-verbal analogies, metaphors, signs, and symbols.</p> <p><b>Art and Design knowledge:</b> Awareness about art/artefact/product, artists/designers, art/design history and trends.</p> <p><b>Design methods and practices:</b> Knowledge of media, materials, production processes, and ergonomics</p>	305
6.	Electronics and Communication Engineering	M. Tech. in Bioelectronics	B.E./B.Tech. level courses in Electronics Engineering, Electrical Engineering, Instrumentation Engineering, Communication Engineering, Biomedical Engineering, Chemical Engineering, Bioengineering, Computer Science and Engineering, Biotechnology. M.Sc. level courses on Chemistry, Biophysics, Molecular Biology, Cell Biology and Molecular Biology and Biotechnology.	306
7.	Electronics and Communication Engineering	M. Tech. in Electronics Design and Technology	B.E. or equivalent level courses on Electronics and Communication Engineering, Electrical Engineering/ AMIE level courses in Electronics/Instrumentation Engineering.	307

8.	Energy	M. Tech. in Energy Technology	Energy sources and Energy conservation, Graduate level courses in Science and Engineering.	308
9.	Food Engineering and Technology	M. Tech. in Food Engineering and Technology	<p><b>Part-I: Mathematics and General Engineering (weightage: 20%)</b></p> <ul style="list-style-type: none"> <li>• Mathematics at the level of B. Tech. 1st and 2nd Semester</li> <li>• General Engineering: Thermodynamics; Fluid Mechanics; and Heat &amp; Mass Transfer</li> </ul> <p><b>Part-II: Food Engineering &amp; Technology (weightage: 80%)</b></p> <p>Food Engineering; Food Chemistry &amp; Nutrition; Food Microbiology; Food Product technology (As per the outline of GATE syllabus for Food Technology, copy attached)</p>	309



10.	Mechanical Engineering	M.Tech. in Mechanical Engineering (Specialization: Machine Design; Thermo Fluids)	<p><b>Engineering Mathematics</b></p> <ul style="list-style-type: none"> <li>□ Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors</li> <li>□ Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.</li> <li>□ Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler- Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.</li> <li>□ Complex variables: Analytic functions; Cauchy- Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.</li> <li>□ Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.</li> <li>□ Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi- step methods for differential equations.</li> </ul> <p><b>Applied Mechanics and Design</b></p> <ul style="list-style-type: none"> <li>□ Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation.</li> <li>□ Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing</li> <li>□ of materials with universal testing machine; testing of hardness and impact strength.</li> <li>□ Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.</li> <li>□ Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.</li> <li>□ Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.</li> </ul> <p><b>Fluid Mechanics and Thermal Sciences</b></p> <ul style="list-style-type: none"> <li>□ Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings; basics of compressible fluid flow.</li> <li>□ Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat</li> </ul>	310
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11.	Electrical Engineering	M.Tech in Electrical Engineering	Same as the GATE 2024 syllabus of Electrical Engineering (EE).	311

12.	Assamese	M.A. in Assamese	<p><b>Assamese Literature</b></p> <ul style="list-style-type: none"> <li>□ A brief history of Assamese Literature (From beginning to present times)</li> </ul> <p><b>Assamese Language and Script</b></p> <ul style="list-style-type: none"> <li>□ A brief history of Assamese Language (From beginning to present times)</li> <li>□ Evolution of Assamese Script</li> <li>□ Dialectology and dialects of Assamese Language</li> <li>□ Assamese Phonology and Morphology</li> </ul> <p><b>Assamese Culture</b></p> <ul style="list-style-type: none"> <li>□ Assamese Folklore</li> <li>□ Cultural History of Assam</li> <li>□ Fairs and Festivals of Assam</li> <li>□ Ethnic groups of Assam and their cultural contributions</li> </ul> <p><b>Critical Theory (Eastern and Western)</b></p>	312
13.	Cultural Studies	M.A. in Cultural Studies	<p>Issues related to North East India, History, Culture, Folklore, Society Performing Arts, Literature of NE India, Matters of Contemporary Importance, Film, Sports, Indian Literature, Indian Culture etc.</p>	313
14.	Education	M.A. in Education	<ul style="list-style-type: none"> <li>■ <b>Philosophical Perspective in Education:</b> Philosophy and Education, Idealism, Naturalism, Pragmatism, Educational Practices – Kindergarten, Montessori, Dalton Plan, Project Method etc.</li> <li>■ <b>Sociological Perspective in Education:</b> Education in relation to Society, Agencies of Socialization, Social Change, Social mobility and stratification etc.</li> <li>■ <b>Psychological Perspective in Education:</b> Educational Psychology and Theories, Learning, intelligence, personality, child's growth and development etc.</li> <li>■ <b>Educational Technology:</b> Concept and scope of Educational Technology, Educational Communication, Emerging technologies in education- ICT in Education, Technology based learning, MOOCs, SWAYAM, smart classroom etc.</li> <li>■ <b>Contemporary Issues in Education:</b> Educational scenario of India, Inclusive Education, RTE Act 2009, Education for peace, yoga and gender, Constitutional Provisions, Environmental Education etc.</li> </ul>	314
15.		B.Ed.	<ul style="list-style-type: none"> <li>□ General Awareness-Current affairs, important facts, politics, education, geography, economics etc. Teaching Aptitude-Teaching-Learning, Teacher's role, Classroom communication etc.</li> <li>□ Contemporary Issues in Education- Educational scenario of India, Inclusive Education, RTE Act 2009, Education for peace, yoga and gender, Constitutional Provisions, Environmental Education etc.</li> <li>□ ICT in Education- Online Learning Platforms, Massive Open and Online Courses, classroom communication, teaching learning aids, Educational technology, Web 2.0 Technologies etc.</li> <li>□ Perspectives in Education-Philosophical, Sociological and Psychological.</li> </ul>	315
16.	English	M.A. in English	<ul style="list-style-type: none"> <li>■ BA Honours/Major level syllabi taught in Indian universities - Reading Literature (Genres, Movements, Schools, Terms), History of English Literature, English Poetry: Chaucer to Dryden, British Drama: Beginning to Shakespeare, Fiction: Early English Novels, English Poetry: The Augustans and the Romantics, Literary Theory and Criticism, Drama: Jacobean to Eighteenth Century, Fiction: Victorian and Modern, Poetry: Victorian to Modern, The English Essay, English Non-fictional Prose, Drama: Nineteenth and Twentieth Century, English for Communication, Phonetics of English and ELT, Postcolonial Literature.</li> <li>■ English grammar, composition, comprehension, vocabulary, phrases and idioms, current affairs, great authors, books, prizes.</li> </ul>	316

17.	Linguistics and Language	M.A. in Linguistics and Language Technology	Basic grammar (syntax, morphology, phonetics, semantics), language and animal communication, English grammar (+12 level), sociolinguistics, language and society, bilingualism, multilingualism, languages and linguistic situation of Northeast, scheduled languages and non-scheduled languages, language endangerment, language policies and planning.	317
18.	Hindi	M.A. in Hindi	Hindi Vyakaran, Hindi Bhasha, Hindi Sahitya, Bharatiya Aur Paschatya Kavya-Shastra, Hindi Patrakarita.	318
19.	Law	Master of Laws (LL.M)	<b>Constitutional Law:</b> Preamble, Salient features of the Indian Constitution, Citizenship, Fundamental Rights, Writ Jurisdiction, Directive Principles of State Policy and Fundamental Duties, Judiciary, Executive, Parliament and State Legislatures, Amending Process of the Constitution, Union State Relationship and Emergency Provisions. <b>Jurisprudence:</b> Nature and Sources of Law, Schools and Concepts of Jurisprudence. <b>Law of Crimes:</b> Fundamental elements of crime, stages of crime, general explanations and exceptions, abetment, conspiracy and attempt, punishments, offences against state, offences affecting common well-being, offences affecting the human body, offences against property, offences relating to marriage and offences affecting reputation. <b>Family Law:</b> Concepts in Family Law, Sources of Family Law in India, Marriage and Dissolution of Marriage, Adoption and Guardianship, Succession, Maintenance, Matrimonial Remedies and Uniform Civil Code <b>Public International Law and Human Rights:</b> Nature and definition of international law, Sources of International Law, Relationship between international law and municipal law, State recognition and state succession, Treaties: Formation, application, termination and reservation, UNO and its organs, Concept and Development of Human Rights, International Bill of Human Rights and Implementation of Human Rights in India. <b>Current Legal Affairs.</b>	319
20.	Mass Communication and	M.A. in Mass Communication	English language and grammar, Current affairs, General knowledge, a basic level of awareness about various aspects of mass media at national and international level for objective type questions. Observational, analytical and creative writing skills for descriptive questions.	320
21.	Social Work	M.A. in Social Work	Current affairs, Logical Reasoning, Awareness on Social welfare schemes, Social Reform movements, Contemporary Social Issues, Rights Based Issues, Quantitative aptitude, Indian Constitution, Basic Concepts in Social Work, Social Legislations, Human Resource Management, English Language Proficiency, Basic Concepts in Social Science (Sociology, Economics, Political Science, Psychology, Research Methods in Social Sciences, Issues in North East India, Environmental and Ecological Issues	321
22.		M.A. in Women Studies	Women's History, ICT, Current Affairs, Mental Ability, Human Rights , Women's Development schemes.	322
23.	Sociology	M.A. in Sociology	<b>Sociology - Concepts and Principles:</b> Definition and Emergence, Basic Concepts, Basic understanding of the works of Marx, Weber, Tonnies, Durkheim, Parsons and Merton, Basic kinship terminologies. <b>Indian Society: Basic Concepts:</b> Caste, Varna, village, region, religion, Processes of Social Change: Sanskritisation, Westernisation, Modernisation, Development and Change, Nation, Nationalism and nation Building. <b>Northeast India:</b> Basic understanding of the Region: Geography, Economy, Polity, Society, Language and Culture, Ethnicity and Identity Politics. <b>General Awareness:</b> National and International: Current Affairs, Basic knowledge of culture, politics, geography, history and science, Basic information about the Indian Constitution.	323

24.	Business Administration	Master of Tourism and Travel Management (MTTM)	<ul style="list-style-type: none"> <li>■ General Knowledge - Tourism destinations of Northeast India, India and the world.</li> <li>■ History and mythology of Northeast India and India.</li> <li>■ Current Affairs.</li> <li>■ English - English Grammar; Sentence formation.</li> <li>■ Reasoning.</li> </ul>	324
25.	Commerce	M.Com.	Accounting and Financial Management, Economics, Business Mathematics and Statistics, Banking, Insurance, Taxation, Management, Business Laws, General Business Awareness.	325
26.	Chemical Sciences	M.Sc. in Chemistry	Inorganic Chemistry, Quantum Chemistry & Chemical Bonding, Organic Chemistry, Physical Chemistry, Spectroscopy from Undergraduate level curriculum of all leading Indian Universities	326
27.	Environmental Science	M.Sc. in Environmental Science	Botany, Zoology, Agriculture, Physics, Chemistry, Mathematics, Statistics, Earth and Environmental Science from Undergraduate level curriculum of Indian Universities.	327
28.	Mathematical Sciences	M.Sc. in Mathematics	Classical Algebra; Calculus; Co-ordinate Geometry; Vectors; Differential Equations; Mechanics; Real Analysis;; Abstract Algebra; Numerical Methods; Linear Algebra; Linear Programming; Topology and Functional Analysis; Number Theory; Complex Analysis:	328
29.	Physics	M.Sc. in Physics	B.Sc. level syllabus of any Indian University (Classical Mechanics, Properties of matter, Quantum Mechanics, Atomic Physics, Solid State Physics, Nuclear Physics, Mathematical Physics, Thermodynamics and Statistical Physics, Electricity and Magnetism, Electronics)	329

## Ph.D. Programmes

S. No	Department/ Centre	Syllabus for TUEE24	TUEE Code
1.	Ph.D in Assamese	History of Assamese Literature; History of Assamese Language and Script; Culture of Assam; Literary Theory and Criticism (Eastern and Western); Research Methodology	401
2.	Ph.D in Cultural Studies	Cultures in contemporary and historical perspectives; Cultural Studies as a discipline; Cultural Memory, Cultural History, Oral History; Contemporary Ethnography, Material Cultures, Media and Culture, Digital Archiving, Visual Culture, Gender Studies, Folk and Literary Cultures, Culture and Environment, Research Methods	402
3.	Ph.D in Education	Research Methodology in Education- Concept of Educational Research, Methods of Research, Approaches of Research, Hypothesis, Synopsis, Sample-population, Designs of Research, Descriptive and Interferential Statistics, Research Report, Bibliography Etc. Contemporary issues in Education- Educational scenario of India, Inclusive Education, RTE Act 2009, and Education for peace, yoga and gender, Constitutional Provisions, Environmental Education etc. Perspectives in Education- Philosophical, Sociological and Psychological foundation of Education.	403
4.	Ph.D in English	Div -I: English Language Teaching English in the global context, ELT in India in historical perspective. Principles and practice of ELT - Language acquisition, language learning-theories, principles; Language skills; Language teaching-different approaches (methods, techniques, procedures); Teaching of literature; Evaluation, testing. Syllabus designing and material production. English for Specific/Academic Purpose. Div -II: American Literature Research Methodology, Literary Theory and Criticism, American Literature Div -III: Indian Literature Research Methodology, Literary Theory and Criticism, Indian Writing in English Div -IV: Gender and Literature Research Methodology, Literary Theory and Criticism, Gender and Literature Div V: Life Writing, Travel Writing Research Methodology, Literary Theory and Criticism, Life Writing, Travel Writing Div VI: Film Adaption, Popular Culture Research Methodology, Literary Theory and Criticism, Life Writing, Travel Writing Div VII: Anglophone South Asian Literature, Ecocriticism Research Methodology, Literary Theory and Criticism, Life Writing, Travel Writing	404
5.	Ph.D in Hindi	हिंदी भाषा की उत्पत्ति और विकास, हिंदी भाषा की संरचना, भाषा विज्ञान, हिंदी साहित्य का इतिहास, हिंदी आलोचना, अनुवाद विज्ञान, हिंदी पत्रकारिता, लोक साहित्य, तुलनात्मक साहित्य, भारतीय काव्यशास्त्र, पाश्चात्य काव्यशास्त्र, राजभाषा हिंदी, समकालीन हिंदी साहित्य, हिंदी सिनेमा, शोध प्रविधि और शोध दृष्टि	405
6.	Ph.D in Linguistics and Language Technology	Modern Linguistic theories (formal and functional, especially, Chomsky's generative theory, Cognitive Linguistics, Construction Grammar); Morphology; Phonetics and Phonology; Semantics and Pragmatics; Philosophy of Language (e.g. ordinary language philosophy; logical positivism); Sociolinguistics (e.g. bilingualism, multilingualism, politeness; Critical Discourse Analysis), Languages and linguistic situation of Northeast, Scheduled languages and non-scheduled languages, Language endangerment, Language policies and planning.	406

7.	Ph.D in Mass Communication and Journalism	Research methodology for social sciences, theoretical concepts of communication and media, a higher level of critical awareness about various important issues of mass media at national and international level.	407
8.	Ph.D in Social Work	<ul style="list-style-type: none"> <li>■ Social Work</li> <li>■ Social work and allied social science theories</li> <li>■ Social science research and statistics</li> <li>■ General knowledge and aptitudes</li> <li>■ Developmental issues</li> <li>□ Civil society issues</li> </ul>	408
9.	Ph.D in Sociology	<p><b>Research Methodology:</b> Philosophy, science and research, Theory and field, Social research strategies, Research designs and sample designs, Planning a research project and formulating research questions, Reviewing the literature, Ethics in social science research, Nature of quantitative research, Nature of qualitative research, Participant observation and ethnography, Triangulation: mixed methods research, Problem of objectivity and subjectivity.</p> <p><b>Sociological Theory:</b> Classical sociological traditions: Marx, Durkheim, Weber, Approaches to social reality: Positivism, Hermeneutics, Post- structuralism, Post- modernism, Functionalism and its critiques, Neo- functionalism, Structuralism, Social structure as model, Structuration, Critical theory and Frankfurt School, Symbolic Interactionism, Phenomenology, Ethnomethodology, Dramaturgy.</p> <p><b>Indian Society:</b> Theories of Social Change in India, Caste, Varna and Class, Kinship systems, Secularism and Communalism, Nationalism, Nation Building, Regionalism..</p>	409
10.	Ph.D. in Women Studies	Women's history, feminist research methodology, women and development, women and health	410
11.	Ph.D in Business Administration	<p>General Awareness: National and international economic environment, conceptual background and applications in economic theory. (20)</p> <p>General English: Basic English grammar (20)</p> <p>General Reasoning: Basic arithmetic and mathematics, Quantitative and alphabetic reasoning, pictorial reasoning. (20)</p> <p>Research Methodology: Basic statistical tools: Measures of Central Tendency, Measures of Dispersion; Correlation; Index Numbers; Time series analysis; Sources of Data: Primary and Secondary sources, Observation and Self-reported data; Basics of Sampling: Sample Vs. Census; Probabilistic Sampling Techniques, Non- Probabilistic Sampling Techniques; Scales of Measurement' Validity and reliability; Basics of Hypothesis Testing: Null and alternative hypothesis; Basic hypothesis testing tools: Chi square test, z test, t test, Analysis of Variance; Style of Referencing: American Psychological Association (APA) 7th Edition style.(40)</p>	411
12.	Ph.D in Commerce	<ol style="list-style-type: none"> <li>1. Research Methodology</li> <li>2. Accounting (PG and NET Standard)</li> <li>3. Finance (PG and NET Standard)</li> <li>4. Economics (including Indian Economy)</li> </ol>	412
13.	Ph.D in Chemical Sciences	Organic Chemistry, Inorganic Chemistry, Physical and Quantum Chemistry, Polymer Chemistry, Analytical Chemistry, Spectroscopy, Interdisciplinary topics from post graduate level curriculum of all leading Indian Universities.	413
14.	Ph.D in Environmental Science	B Earth and Environmental Science, Mathematics, Statistics, Physics, Chemistry, Botany, Zoology, and Agriculture, from master's level curriculum of Indian Universities.	414
15.	Ph.D in Mathematical Sciences	Linear Algebra, Abstract Algebra, Real Analysis, Complex Analysis, Functional Analysis, Topology, Ordinary and Partial Differential Equations, Numerical Analysis, Measure Theory, Classical Mechanics,	415

16.	PhD in Applied Mathematics	Probability and Statistics, Mathematical Programming, Number Theory, Special Functions, Integral Equations and Transforms, Calculus of Variation.	415A
17.	Ph.D in Molecular Biology & Biotechnology	Master (MSc/MTech)/B.Sc (Graduation) level Life Science (includes Botany, Zoology, Microbiology, Biochemistry, Cell Biology, Physiology, Genetics etc.), basic bioinformatics, and Higher Secondary level Physics, Chemistry and Mathematics.	416
18.	Ph.D in Physics	M.Sc. Physics syllabus of any Indian University (Quantum Mechanics, Classical Mechanics, Mathematical Physics, Condensed matter Physics, Statistical Physics, Atomic and Molecular Physics, Nuclear and Particle Physics, Astrophysics, Electrodynamics, Electronics)	417
19.	PhD in Applied Physics		417A
20.	Ph.D in Civil Engineering	<p>Soil formation, Soil structure, Soil properties, Permeability and seepage, Stress distribution in soils, Compaction, Consolidation, Shear strength, Soil exploration &amp; site investigation, Shallow foundations, Deep Foundations, Ground improvement techniques, Lateral earth pressure, Stability of slope, Introduction to soil dynamics &amp; machine foundation, Liquefaction of soils, Pavement material.</p> <p>Water and Wastewater Quantity Estimation, Water Quality, Microbiology, Environmental Chemistry, Dissolved oxygen Model, Sewer Design, Type I and II suspensions, Sedimentation Tanks, Coagulation and Flocculation, Hydraulics of Filtration, Disinfection Methods, Ion exchange and Adsorption, Water Softening, Manganese and Iron Removal, Wastewater treatment, Septic tank, wastewater stabilization ponds, aerated ponds and oxidation ditches.</p> <p>Fluid properties, Application of the continuity, momentum and energy equations, Flow in pipes, Boundary Layer theory, forces on submerged bodies, hydrostatic forces on bodies, buoyancy, kinematics of flow, dynamics of fluid flow, Dimensional analysis; flow in open channel, hydraulic machines, Hydrologic cycle, precipitation and abstraction losses, hydrograph analysis, flood estimation, groundwater hydrology –well hydraulics, aquifers, Darcy's Law, irrigation systems and methods, Gravity Dams and Spillways</p> <p>Pavement materials, Pavement analysis and design, Highway construction and maintenance, Bituminous mix design</p>	418
21.	Ph.D in Computer Science & Engineering	<p>Discrete Mathematics, probability, statistics, algebra</p> <p>Data structures-Array, stack, queue, linked list, binary tree, heap, AVL tree, graph.</p> <p>Programming languages- C, C++.</p> <p>Design and analysis of algorithms-Asymptotic notation, sorting, selection, searching.</p> <p>Computer organization and architecture – Number representation, computer arithmetic, Logic Design, Boolean algebra, memory organization, I/O Organization.</p> <p>Operating systems - Memory management, processor management, critical section problem, deadlocks.</p> <p>Formal languages and automata theory - Finite automata and regular expressions, push down automata, context-free grammars, Turing machines, elements of undecidability.</p> <p>Database management systems - Relational model, relational algebra, relational calculus, functional dependency, normalization (up to BCNF).</p> <p>Computer networks – Physical layer, LAN technology, MAC protocols, circuit switching, packet switching, data encoding, routing, flow control, error detection/correction, Internetworking, TCP/IP networking protocols.</p> <p>Principles of Compiler Construction-Lexical analyzer, parser, syntax-directed translation, intermediate code generation.</p>	419



22.	Ph.D in Design	<p>Section I :</p> <p>Visualization and spatial ability: Pictorial and diagrammatic questions to test the understanding of transformation and/or manipulation of 2D shapes and 3D objects and their spatial relationships.</p> <p>Environmental and social awareness: General awareness of environmental factors (such as climate, population, water, vegetation, pollution, weather, natural resources) and their implications on the design of products, images, infrastructure and environment. Awareness of design terminologies, social and cultural connection with design, history of the designed artefact, and socially responsible and environmentally sustainable design responses. History of art, sculpture and literature.</p> <p>Analytical and logical reasoning: Ability to analyse given information logically and select the most appropriate solutions; ability to weigh opinions, arguments or solutions against appropriate criteria; ability to use logic and structured thinking to deduce from a short passage, which of a number of statements is the most accurate response to a posed question.</p> <p>Language and creativity: Ability to understand passages in commonly used English language; ability to think creatively in terms of alternatives; ability to distinguish innovative options and think out-of-the-box.</p> <p>Design thinking and problem solving: Ability to understand the context, the users and the constraints and select the most appropriate solution for a given design problem.</p> <p>Observation and design sensitivity: Ability to detect concealed properties in day-to-day life and think critically about them. Ability to discern subtle differences in visual properties and aesthetic outcomes.</p> <p>Section II :</p> <p>Product Design: Product life cycle and stages. Design Toolkits, Design selection and concept development : intuitive and directed methods. Product architecture and its types, importance of aesthetic and usability. Prototyping -Tools, materials, and techniques.</p> <p>Ergonomics : - Overview, objective, and application. MME interaction; Human Factors and its fundamentals, mutual task comfort. Anthropometry - Human body, various postures, and movements, measuring techniques; Biomechanics and its applications.</p> <p>Design Research Methodologies: Design Research Strategies, Methodologies, Techniques and Procedures. Systematic literature review; Interviews: types &amp; techniques; Questionnaires; Observation techniques; Participatory methods; Cognitive Task Analysis; Mental model elicitation; Contextual inquiry; Needs assessment; Thematic analysis; Think-aloud technique.</p>	420
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23.	Ph.D in Electrical Engineering	<p>Verbal Aptitude: Basic English grammar: tenses, articles, adjectives, prepositions, conjunctions, verb-noun agreement, and other parts of speech. Basic vocabulary: words, idioms, and phrases in context Reading and comprehension Narrative sequencing.</p> <p>Quantitative Aptitude: Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing the data), 2-and 3-dimensional plots, maps, and tables Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability.</p> <p>Analytical Aptitude: Logic: deduction and induction, Analogy, Numerical relations and reasoning.</p> <p>Spatial Aptitude: Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping Paper folding, cutting, and patterns in 2 and 3 dimensions</p> <p>General &amp; Engineering Mathematics: Linear Algebra, Calculus, Differential Equations, Linear Equation, Quadratic Equations, Complex Variables, Geometry, Probability and Statistics</p> <p>Basic Electrical &amp; Electronics Engineering:  D.C. &amp; AC Circuit Analysis: Independent and Dependent sources, Nodal and Mesh circuit analysis, Source equivalence and conversion, Superposition, Thevenin, Norton, Maximum Power Transfer and Reciprocity theorems. AC fundamentals and Circuits: A.C. generation, waveforms, R-L, R-C and R-L-C circuits, Single Phase and Three-phase circuit analysis: Star and Delta connected Systems, voltages, current and power in 3-phase circuits. Ammeter, voltmeter, Wattmeter.  Semiconductor, diodes, rectifier clipper, clamper. Transistor: BJT, MOSFET. OPAMP: Differentiator, Integrator, SCR</p>	421
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24.	Ph.D in Electronics & Communication Engineering	<p><b>Section 1: Engineering Mathematics:</b>  Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigenvalues and eigenvectors, rank, solution of linear equations- existence and uniqueness  Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.  Differential Equations: First order equations (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems.  Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's and Stokes' theorems.  Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, sequences, series, convergence tests, Taylor and Laurent series, residue theorem  Probability and Statistics: Mean, median, mode, standard deviation, combinatorial probability, probability distributions, binomial distribution, Poisson distribution, exponential distribution, normal distribution, joint and conditional probability.</p> <p><b>Section 2: Networks, Signals and Systems</b>  Circuit analysis: Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, wye-delta transformation. Continuous-time signals: Fourier series and Fourier transform, sampling theorem and applications. Discrete-time signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals. LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.</p> <p><b>Section 3: Electronic Devices:</b>  Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors. 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.</p> <p><b>Section 4: Analog Circuits:</b>  Diode circuits: clipping and rectifiers, BJT and MOSFET amplifiers: biasing, ac coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers. Op-amp circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers and oscillators.</p> <p><b>Section 5: Digital Circuits and Microprocessor:</b>  Number representations: binary, integer and floating-point- numbers. 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 Sequential circuits: latches and flip-flops, counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay. Data converters: sample and hold circuits, ADCs and DACs. Semiconductor memories: ROM, SRAM, DRAM.  8085 Microprocessor: Programmers model, register structure, addressing modes and assembly languages, Interrupts. Peripherals: Programmable interrupt controller (8259), programmable peripheral interface (8255), serial communication (8251), programmable timer and event counter (8254) and DMA controller (8257)</p> <p><b>Section 6: Control Systems:</b>  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 laglead compensation; State variable model and solution of state equation of LTI systems.</p> <p><b>Section 7: Communications and microwave:</b>  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,</p>	422
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		<p>spectra of AM and FM, superheterodyne receivers. Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.</p> <p>Passive Microwave Devices and Components - Reciprocal and non-reciprocal devices and their applications. Guided and Free Space Propagation. Active Microwave Devices - Tubes and Solid State Devices, their principles and applications. Measurement Systems and Measurement Techniques. Microwave Materials and their Properties</p> <p><b>Section 8: Electromagnetics:</b></p> <p>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, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.</p> <p><b>Section 9: Electrical Machines:</b></p> <p>Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles; DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors; Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control; Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Types of losses and efficiency calculations of electric machines</p> <p><b>Section 10: Power Electronics</b></p> <p>Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three-phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of ac to dc converters; Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation.</p> <p><b>11. Sensors and Bioinstrumentation:</b></p> <p>Sensors – resistive, capacitive, inductive, piezoelectric, Hall effect, electrochemical, optical; Sensor signal conditioning circuits; application of LASER in sensing and therapy. Origin of biopotentials and their measurement techniques– ECG, EEG, EMG, ERG, EOG, GSR, PCG, Principles of measuring blood pressure, body temperature, volume and flow in arteries, veins and tissues, respiratory measurements and cardiac output measurement. Operating principle of medical equipment - sphygmomanometer, ventilator, cardiac pacemaker, defibrillator, pulse oximeter, hemodialyzer; Electrical Isolation (optical and electrical) and Safety of Biomedical Instruments.</p>	
25.	Ph.D in Energy	Energy conversion and Energy Systems, Energy-Environment interaction, Instrumentation and control, Electrical energy systems	423
26.	Ph.D in Food Engineering & Technology	Food Engineering; Food Chemistry & Nutrition; Food Microbiology; Food Product technology (As per the outline of GATE syllabus for Food Technology)	424

27.	Ph.D in Mechanical Engineering	<p>Mathematics: Linear Algebra: Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.</p> <p>Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; Fourier series; gradient, divergence and curl, directional derivatives, applications of Gauss, Stokes and Green's theorems.</p> <p>Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; initial and boundary value problems.</p> <p>Applied Mechanics and Design:</p> <p>Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations.</p> <p>Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts.</p> <p>Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses.</p> <p>Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance.</p> <p>Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings.</p> <p>Fluid Mechanics and Thermal Sciences:</p> <p>Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, flow through pipes.</p> <p>Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance heat transfer through fins; lumped parameter system, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan-Boltzmann law.</p> <p>Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; Zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.</p> <p>Applications:</p> <p>Power Engineering: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Refrigeration and air-conditioning.</p> <p>Turbomachinery: Impulse and reaction principles, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines.</p> <p>Materials and Manufacturing Engineering</p> <p>Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.</p> <p>Casting, Forming and Joining Processes: Different types of castings, solidification and cooling; plastic deformation and yield criteria; fundamentals of hot and cold working processes; Principles of welding, brazing, soldering and adhesive bonding.</p> <p>Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; tool life and wear; Metrology and Inspection: Limits, fits and tolerances.</p>	425
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28.	Ph.D in Multi-Disciplinary Research	<p>General aptitude in research as evidenced by comprehensive knowledge on issues related to scientific thinking, research ethics (Good Academic Research Practices), sustainability, development, economy, technology, environment, peace, conflict, and harmony.</p> <p>Comprehensive understanding of programmes and policies of Government of India related to welfare and development, food security, access to education including provisions of NEP2020.</p> <p>Basic understanding of major challenges faced by mankind including global, national, and regional initiatives to combat such challenge (for example, not limited to, modern lifestyle vis-à-vis mental health, exploitation of natural resources vis-à-vis climate change) including SDG and Net Zero targeting.</p> <p>Fundamental knowledge in mathematics, science, statistics, history, creative arts subjects and geography. Working knowledge on ethical use of ICT, and of Language and communication, basic understanding on education as a means of attaining higher order thinking skills and a driver of self-directed learning.</p>	426
29.	Ph.D in Law	<p>Research Methodology</p> <p>Jurisprudence</p> <p>Constitutional Law</p> <p>Criminal Law</p> <p>Public International Law</p> <p>Human Rights Law</p> <p>Family Law</p> <p>Current Legal Affairs</p>	427