

SCHEME OF SYLLABUS

Marking Scheme is as follows:-

- (a) Three marks will be awarded for every correct answer.
- (b) One mark will be deducted for every incorrect answer.
- (c) No marks for unattempted questions.
- (d) Before declaration of result, marks scored by candidates will be normalised.

AIR FORCE COMMON ADMISSION TEST (AFCAT): The AFCAT Question Paper will have 100 questions. The total time allotted for the paper is two hours. Each Question Paper will have questions from the following topics:-

- (a) **English**. Comprehension, Detect Error in Sentence, Sentence Completion/ Filling in of correct word, Synonym/ Antonym, Cloze Test or Fill in the Gaps in a paragraph, Idioms and Phrases, Analogy, Sentence Rearranging, Substitution in a Sentence/ One Word Substitution.
- (b) **General Awareness**. History, Geography, Sports, National & International Organizations, Art & Culture, Personalities, Environment & Ecology, Indian Polity, Economy, Basic Science Based Knowledge, Science & Technology, Current Affairs (National & International), Defence.
- (c) **Numerical Ability**. Decimal Fraction, Time and Work, Average/ Percentage, Profit & Loss, Ratio & Proportion, Simple and Compound Interest, Time & Distance and Races (Trains/ Boats & Streams), Area and Perimeter, Probability, Number System & Number Series, Mixture & Allegation Rules, Clocks.
- (d) **Reasoning and Military Aptitude Test**. Verbal and Non-Verbal Reasoning.

Note: The standard of Numerical Ability Questions will be of Matriculation level. The standard of questions in other subjects will be of graduation level (Indian University).

SYLLABUS FOR MECHANICAL ENGINEERING

FUNDAMENTAL ENGINEERING

1. **Engineering Mathematics**. Matrix Algebra, Eigen values and Eigen vectors, Theorems of integral calculus, Partial derivatives, Maxima and minima, Multiple integrals, Stokes, Gauss and Green's theorems. First order differential equation (linear and nonlinear), Cauchy's and Euler's equations, Complex variables, Taylor's and Laurent's series, Sampling theorems, Mean, Median, Mode and Standard deviation, Random variables, Discrete and Continuous distributions, Fourier transform, Laplace transform, Z-transform.
2. **Engineering Physics**. Units for measurements, Description of Motion in One, Two and Three dimensions, Laws of Motion, Work, Energy and Power, Rotational Motion, Gravitation, Heat and Thermodynamics, Electrostatics, Electric Current, Magnetic Effect of Currents, Magnetism, Electromagnetic Induction and Alternating Currents and Electromagnetic Waves, Ray Optics and Optical Instruments.
3. **Engineering Graphics/ Engineering Drawing**. Principles of orthographic projections, projections of points, lines, planes and solids, Section of solids, Isometric views, Auto-CAD.

CORE ENGINEERING

4. **Engineering Mechanics**. Generalized Hooke's law and its application; design problems on axial stress, shear stress and bearing stress; material properties for dynamic loading; bending shear and stresses in beams; determination of principle stresses and strains - analytical and graphical; material behavior and design factors for dynamic load; design of circular shafts for bending and torsional load only; deflection of beam for statically determinate problems; theories of failure. Stress and Strain: Equations of equilibrium, constitutive law, strain-displacement relationship, compatibility equations, plane stress and strain.
5. **Thermodynamics**. Basic concept of First law and second law of Thermodynamics; concept of entropy and reversibility; availability and unavailability and irreversibility. Classification and properties of fluids; incompressible and compressible fluids flows; effect of Mach number and compressibility; continuity, momentum and energy equations; normal and oblique shocks; one dimensional isentropic flow; flow of fluids in duct with frictions that transfer. Flow through fans, blowers and compressors; axial and centrifugal flow configuration; design of fans and compressors.
6. **Theory of Machines**. Kinematic and dynamic analysis of plane mechanisms. Cams, Gears and epicyclic gear trains, flywheels, governors, balancing of rigid rotors, balancing of single and multi cylinder engines, linear vibration analysis of mechanical systems (single degree of freedom), Critical speeds and whirling of shafts. Flywheels, balancing of rotors and reciprocating machinery, balancing machines, governors, free and forced vibration of damped and undamped single degree of freedom systems, isolation, whirling of shafts, gyroscope.

7. **Fluid mechanics/ Hydraulic Machines**. Fluid flow concepts - Transport theorem – Fluid kinematics - Potential flow - Governing equations of Fluid flow - Dimensional Analysis – Viscous flow - Boundary Layer flows - Turbulence - Closed conduit flows - Hydrodynamic lubrication – Free surface flow - Compressible flows, Hydraulic Turbines: Impulse and Reaction Turbines - Centrifugal and Axial flow pumps.
8. **Manufacturing Science**. Foundry Technology, Melting furnaces, Special casting processes, Gating and riser design, Casting defects, Arc welding, TIG, MIG, submerged arc, resistance welding, Gas welding, Flash butt welding, Solid state welding, Welding metallurgy, Forming Technology, Powder metallurgy.
9. **Materials Science**. Basic concepts on structure of solids; common ferrous and non-ferrous materials and their applications; heat-treatment of steels; non-metals plastics, ceramics, composite materials and nano-materials.
10. **Machine Drawing**. Development and Intersection of surfaces, Conventional representation of machine elements, materials, surface finish and tolerances - Sectional views and additional views - Drawing of Screw threads, locking devices, Fasteners, Keys and Cotters, Knuckle joints, Riveted Joints, Shaft Couplings and Bearings - Pipe Joints, Assembly and production drawings.

ALLIED ENGINEERING

11. **Automotive Engineering**. Power plant, fuel system, electrical systems lubricating system and cooling systems, chassis and transmission, axles, clutches, propeller shafts and differential, condition for correct steering, steering gear mechanisms, automotive air conditioning, Tires, effect of working parameters on knocking, reduction of knocking; Forms of combustion chamber for SI and CI engines; rating of fuels; additives; emission.
12. **Mechatronics**. Sensors & transducers; Drives and actuators, hydraulic & pneumatic actuators, electric actuators such as servo motors, stepper motors, drive circuits, open and closed loop control; Smart materials shape memory alloys, piezoelectric and magnetostrictive actuators.
13. **Industrial Engineering**. System design: factory location- simple OR models; plant layout - methods based; applications of engineering economic analysis and breakeven analysis for product selection, process selection and capacity planning; predetermined time standards. System planning; forecasting methods based on regression and decomposition, design and balancing of multi model and stochastic assembly lines; inventory management – probabilistic inventory models for order time and order quantity determination; JIT systems; strategic sourcing; managing inter plant logistics.
14. **Refrigeration and Air Conditioning**. Advanced vapour compression cycle, Refrigerants and their properties, Ozone depletion and effect upon global warming; Comfort air conditioning, cooling load calculations, application of AC systems, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils.

15. **Composite Materials**. Definition and application of composite materials, fiber glass, carbon ceramic and aramid fibers; Matrix polymers, graphite, ceramic and metal matrices; Characteristics of fibers and matrices; Manufacturing of composite materials; Laminated materials, basic assumption of laminated anisotropic plate.

16. **Aerodynamics**. Basic Fluid Mechanics: Incompressible irrotational flow, Helmholtz and Kelvin theorem, singularities and superposition, viscous flows, boundary layer on a flat plate. Airfoils and wings: Classification of airfoils, aerodynamic characteristics, high lift devices, Kutta Joukowski theorem; lift generation; thin airfoil theory; wing theory; induced drag; qualitative treatment of low aspect ratio wings. Viscous Flows: Flow separation, introduction to turbulence, transition, structure of a turbulent boundary layer. Compressible Flows: Dynamics and Thermodynamics of I-D flow, isentropic flow, normal shock, oblique shock.

SYLLABUS FOR ELECTRICAL AND ELECTRONICS ENGINEERING

FUNDAMENTAL ENGINEERING

1. **Engineering Mathematics**. Matrix Algebra, Eigen values and Eigen vectors, Theorems of integral calculus, Partial derivatives, Maxima and minima, Multiple integrals, Stokes, Gauss and Green's theorems. First order differential equation (linear and nonlinear), Cauchy's and Euler's equations, Complex variables, Taylor's and Laurent' series, Sampling theorems, Mean, Median, Mode and Standard deviation, Random variables, Discrete and Continuous distributions, Fourier transform, Laplace transform, Z-transform.
2. **Engineering Physics**. Units for measurements, Description of Motion in One, Two and Three dimensions, Laws of Motion, Work, Energy and Power, Rotational Motion, Gravitation, Heat and Thermodynamics, Electrostatics, Electric current, Magnetic Effect of Currents, Magnetism, Electromagnetic Induction and Alternating Currents and Electromagnetic Waves, Ray Optics and Optical Instruments.
3. **Engineering Graphics/ Engineering Drawing**. Principles of orthographic projections, projections of points, lines planes and solids, Section of solids, Isometric views, Auto-CAD.

CORE ENGINEERING

4. **Analog and Digital Electronics**. Characteristics of diodes, Amplifiers – biasing, equivalent circuit and frequency response, Oscillators and Feedback amplifiers, Operational amplifiers – characteristics and applications, Simple active filters, VCOs and timers, Combinational and sequential logic circuits, Multiplexers, Schmitt trigger, Multi-vibrators, sample and hold circuits, A/D and D/A converters, 8-bit microprocessors basics, architecture, programming and interfacing.
5. **Electrical Engineering**. DC network theorems, Electrostatics, Magnetism Electromechanical power sources. AC series circuits, Parallel circuits, AC network analysis, AC bridges. DC Generators, Armature Reaction and Commutation, Generator characteristics, DC Motor – speed controlling, testing of DC Machines, Transformer, Three phase transformer, Induction Motor, Single phase motors, alternators, synchronous motors Special Machines.
6. **Electronic Devices**. Energy bands in Silicon, Intrinsic and extrinsic Silicon, Carrier transport in Silicon – diffusion current, drift current, mobility and resistivity. Generation and recombination of carriers, p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, PIN and Avalanche photo diode. Basics of LASER. Device technology – integrated circuits fabrication process, Oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

7. **Control Engineering**. Application of open loop and closed loop systems, Principles of feedback, Determination of transfer function by block diagram reduction method, Time domain analysis of first and second order systems, transient and steady-state errors, damping and oscillations, Routh and Nyquist techniques, Bode plots, Rooty loci, Lag, lead and lead-lag compensation, Controllability and observability.

8. **Analog and Digital communications**. Amplitude Modulation Techniques, Angle Modulation Techniques, Representation of FM and PM signals. Gaussian and white noise characteristics, Noise in AM & FM systems, Pre-emphasis and De-emphasis. Radio receivers – **Super heterodyne Receiver, SNR calculations for FM and AM**. Pulse Modulation Techniques – PAM, PWM, PPM and pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers. Digital Modulation schemes – Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Digital Modulation tradeoffs.

9. **Signals and Systems**. Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with a periodic convergent inputs. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations and difference equations. The idea of signal space and orthogonal bases. **State-space model** analysis and multi-input, multi-output representation. The **state-transition matrix** and its role.

10. **Computer Networks**. ISO/ OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Congestion control, TCP/ UDP and sockets, IPv4, Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concept of hubs, switches, gateways and routers.

11. **Network Theory Design**. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. Circuits, Impulse, step, ramp and sinusoidal response analysis of first order and second order circuits. Two port parameters and their interrelations, Analysis of RC, RL and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions. Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations.

ALLIED ENGINEERING

12. **Instrumentation**. Accuracy, precision and repeatability, Electronic instruments for measuring basic parameters, Theory of Oscilloscopes, Signal generators, Signal analysers, Characteristics and construction of transducers.

13. **Switching Theory**. Traffic definitions, Introduction to switching networks, classification of switching systems. Grade of Service, Basics of Circuit switching and packet switching.

14. **Fibre Optic Communication**. Introduction to vector nature of light, propagation of light. Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR. Optical amplifiers – EDFA, Raman amplifier.
15. **Radar Theory**. Radar range equation, Frequencies of operation, Fundamentals Moving Target Indicator, Pulse Doppler Radar, Tracking Radar.
16. **Microwave Engineering**. Wave guides, Wave guide components, Klystrons, Travelling Wave Tubes, Magnetron, Microwave measurements, Microwave semiconductor devices, Monolithic microwave integrated circuits.
17. **Antenna and Wave Propagation**. Basic Considerations, Wire Radiators in space, Antenna gain and effective radiated power, Radiation measurement and field intensity, Antenna resistance, Bandwidth, beam width and polarization, ungrounded antennas and grounded antennas. Electromagnetic radiation, Propagation of various types of waves – Ground waves, sky wave propagation, space waves, tropospheric scatter and extraterrestrial communications.

SYLLABUS FOR COMPUTER SCIENCE ENGINEERING

FUNDAMENTAL ENGINEERING

1. **Engineering Mathematics**. Matrix Algebra, Eigen values and Eigen vectors, Theorems of integral calculus, Partial derivatives, Maxima and minima, Multiple integrals, Stokes, Gauss and Green's theorems. First order differential equation (linear and nonlinear), Cauchy's and Euler's equations, Complex variables, Taylor's and Laurent' series, Sampling theorems, Mean, Median, Mode and Standard deviation, Random variables, Discrete and Continuous distributions, Fourier transform, Laplace transform, Z-transform.
2. **Engineering Physics**. Units for measurements, Description of Motion in One, Two and Three dimensions, Laws of Motion, Work, Energy and Power, Rotational Motion, Gravitation, Heat and Thermodynamics, Electrostatics, Electric current, Magnetic Effect of Currents, Magnetism, Electromagnetic Induction and Alternating Currents and Electromagnetic Waves, Ray Optics and Optical Instruments.
3. **Engineering Graphics/ Engineering Drawing**. Principles of orthographic projections, projections of points, lines planes and solids, Section of solids, Isometric views, Auto-CAD.

CORE ENGINEERING

4. **Basic Electrical Engineering**. D.C. Circuits, Superposition, Thevenin and Norton Theorems, Time-domain analysis of first-order RL and RC circuits. A.C. Circuits, Three-phase balanced circuits, voltage and current relations in star and delta connections. Transformers, Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. Electrical Machines, their Construction, Loss components and efficiency, Single-phase induction motor. Construction and working of synchronous generators. Power Converters, Electrical Installations, Earthing, Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.
5. **Data structure & Algorithms**. Basic Terminologies & Data Organizations, Data Structure Operations, Analysis of an Algorithm, Asymptotic Notations, Searching and their complexity analysis. Stacks and Queues, Types, their operations and complexity analysis. Linked Lists, Types, their operations, complexity analysis and representation in memory. Trees, Their types, Operations, algorithms with complexity analysis. Sorting and Hashing, Algorithms, operations with complexity analysis. Performance and Comparison among all the methods.
6. **Computer Organization & Architecture**. Functional blocks of a computer, CPU, memory, I/O & control, addressing modes & operations cycles. Data representation: signed number, fixed/ floating point and character representation. Computer arithmetic, types of adders, subtractors, multipliers, dividers and floating point arithmetic.

Introduction to x86 architecture. CPU, Memory & its organization, Peripheral devices and their characteristics: Input-output device interface & transfers program, interrupt, DMA etc.

7. **Operating Systems.** Operating systems, Types, Services, System Calls, Structure of an OS-Layered, Virtual Machine. Processes & its relationship, states, transitions, Process Control Block (PCB), Context switching, Thread and various states, Process Scheduling and its objectives, types & criteria. Inter-process Communication, Semaphores, Classical IPC Problems, Deadlocks and Recovery. Memory Management, fragmentation, Paging, Protection and sharing, File Management, efficiency and performance, Disk Management.

8. **Database Management Systems.** Database system architecture, ER, network and object oriented data models. Relational algebra, Relational database design, Query processing and optimization. Transaction processing and Database Security.

9. **Computer Networks.** Data communication networks and Topologies, Protocols and Standards, Transmission Media, Techniques for Bandwidth utilization. Data Link Layer and Medium Access Sub Layer functioning. Flow Control and Error control protocols. Network Layer switching, Logical addressing, mapping, routing and forwarding protocols. Transport Layer Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques. Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

ALLIED ENGINEERING

10. **Analog Electronic Circuits.** P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits. BJT circuits and its uses in different configurations. Structure and I-V characteristics. MOSFET circuits and its uses, structure and I-V characteristics.

11. **Digital Electronics.** Fundamentals of Digital Systems and logic families, Boolean algebra, number systems, error detecting and correcting codes, characteristics of digital ICs, digital logic families. Combinational Digital Circuits, K-map representation, Multiplexer, De-Multiplexer/ Decoders, ALU, elementary ALU design, Sequential circuits and systems. A/D and D/A Converters. Semiconductor memories and Programmable logic devices.

12. **Telecommunication Systems.** Amplitude and Frequency modulation and fundamentals of Optical Fiber communication.

13. **Radar Theory.** Radar functioning and applications.

14. **Instrumentation.** Electronics instrument for measuring various basic parameters and accuracy, precision and repeatability.