

Nepal Telecom

Nepal Doorsanchar Company Ltd.

Syllabus

Part II(Specialized subject for Mechanical Engineer Level 7 Tech.- Free and Internal competition)

Time: 2 hours

Full Marks: 100

Pass Marks: 40

Part II (Specialized Module) All the Questions are Compulsory

| Types of question | Number of questions | Marks | Total Marks | Remarks |
|---------------------|---------------------|-------|-------------|--|
| Objective Questions | 30 | 1 | 30 | 1/4 marks will be deducted for each incorrect answer |
| Short Questions | 10 | 4 | 40 | |
| Long Questions | 3 | 10 | 30 | |
| | | | 100 | |

Use of non-programmable calculator is permitted in the examination hall.

1. Strength of Materials (15 ~ 25%)

- a) Stress & Strain : Concept of stress and strain, axial loading, normal stress, shearing stress, bearing stress, components of stress, deformation, normal strain, stress-strain diagram, Hook's Law, modulus of elasticity, anisotropic and isotropic elasticity, elastic and plastic behaviour, Poisson's ratio, multi axial loading, shearing strain, stress concentration & Plastic deformations, transformation of stress and strain, principal stresses, Maximum shearing stress, Mohr's Circle for Plane Stress, general state of stress, yield criteria for ductile and brittle material, principle of stationary potential energy, Castigliano's theorem on linear deflections, deflections of statically determinate and indeterminate structures, theories of failure, fatigue strength, ductile and brittle material, factor of safety
- b) Torsion & Bending : Stresses and deformations in Uniform shaft, shear stresses and angle of twist, shear stresses in a beam, beam stresses in pure bending, deformations of symmetric member in pure bending, stresses and deformation in the elastic range, stress concentration and plastic deformation, torsion of a bar of cylindrical cross section, saint-Venant's semi-inverse Method, linear elastic solution, the Prandtl elastic member analogy, torsion of a narrow rectangular cross section, fully plastic torsion

- c) Beam shaft and column: Shear and bending moment diagrams, relation among load, shear and bending moment, principal stresses in a beam, stresses under applied load, equation of beam bending, integrations to obtain deflected shape, statically indeterminate beam, moment-area theorem, application to cantilever beams and symmetric and unsymmetrical loading, maximum deflection in shaft, stability of structure under load, Euler's formula for Pin-ended columns.

2. Thermodynamic (15 ~ 25%)

- a) Properties of gasses and gas laws: the ideal gas and equation of state, specific heat, Boyle's Law and Charle's Law, the gas constant and relation between C_p and C_v , Internal energy and Enthalpy, constant volume and constant ressure process for P-V and T-S planes, Isothermal Process, adiabatic & Isentropic process, relationship among p, V, T, work and heat
- (b) Thermodynamic system and processes: thermodynamic properties, closed system, open system, working substances, pure substance: properties and state, First Law and Second Law of thermodynamics, Steady-state and steady flow process, Uniform-state and uniform flow process, conservation of energy, potential, kinetic and internal energy, heat and thermal equilibrium, Enthalpy applied to the steady flow energy equation
- (c) Heat transfer: Thermal conductivity, Fourier's law of heat conduction, heat transfer coefficient, Newton's law of cooling, nature of radiation, Stefan-Boltzmann law, Insulation, one and two dimensional steady state heat conduction, laminar and turbulent boundary layers (flat plates and tubes), heat transfer for flat plates and tubes, correlations for flow across cylinders & tube banks, free convection from plates and cylinder, heat exchanger design considerations, nature of radiation and concept of black body radiations, radiation properties, emissivity, absorptivity and reflectivity, radiation interchange between grey bodies

3. Applied Thermodynamic (Air-Condition) (15 ~ 25%)

- (a) Refrigeration system: Carnot cycles, refrigerators and heat pumps, vapor compression refrigeration cycles, actual and ideal cycles, representation on T-s and p-h diagrams, work done, absorption refrigeration system, basic absorption cycle, refrigerants and their classification and properties, coefficient of performance,
- (b) Air-conditioning: Basic properties of air, moist air, Dalton's law of partial pressures, relative humidity, humidity ratio and dew point temperature, Psychrometric properties and use of psychrometric chart, processes with moist air, heating and cooling, cooling and dehumidification, heating and humidification, evaporative cooling, unitary and central air-conditioning system

- (c) Components of Air-conditioning system: ducts, fans, air handling units, registers, diffusers, humidifiers and dehumidifiers, reciprocating and scroll type compressors
 - (d) Load design of air-conditioning system
- 4. Applied Thermodynamic (Heat Engine) (15 ~ 25%)**
- (a) Internal Combustion Engine: Classification of engine, basic engine parameters, operating cycles, engine components.
 - (b) Air – Standard Engine Cycle: Pressure-volume diagrams, air-standard analysis for constant volume cycle and constant pressure cycle.
 - (c) Performance of Internal Combustion Engine: Brake power, performance curves, fuel and fuel system, ignitions systems, cooling systems, lubrication system
- 5. Machine Dynamics (5 ~ 15%)**
- (a) Linkages and mechanisms, kinematics of mechanisms, force analysis of mechanism.
 - (b) Engine force analysis: Dynamically equivalent masses, force and torque analysis, flywheel sizing for speed fluctuation control
 - (c) Force analysis of cams and followers: Classification and nomenclature of cams and follower, graphical layout, standardized follower displacement or lift curves, analytical cam design, other cam layouts, cam productions method, force analysis
 - (d) Forces on gear teeth: classification and nomenclature, spur gear, geometry of involutes, characteristics of involute tooth action, Interference of involute gears, numbers of teeth to avoid interference, backlash in involute gears, methods of gear production, theory of straight bevel gears, bevel gear tooth proportions and geometrical details, spiral and hypoid gears, theory of helical gears & tooth geometry, parallel and crossed shaft for helical gears, worm gearing, theory of planetary gear trains, speed ratio, formula and tabular methods, applications, assembly of planetary gear trains, forces on gear teeth
 - (e) Flywheels and governor:
 - (f) Balance of Machinery and vibration: Single plane balancing of a disk, two plane balancing of a rigid rotor, one and two-plane field balancing, types of balancing machines, unbalance in single cylinder engine, balance of reciprocating masses, balance of reciprocating masses, balance of multi-cylinder engines/compressor,

ibration of single degree of freedom system, vibrations of discrete mass system, continuous systems

(g) Metal fits and tolerances, factor of safety, types of failure

6. Workshop Technology (5 ~ 15%)

(a) Bench Tools and basic operations, different types of welding, sheet metal works and metal jointing

(b) Power tools, measuring and gauging tools

(c) Machine and machine tools, lathe machine, shaping machine, drilling machine, milling machine, grinding machine etc.

(d) Properties of materials, tolerance and fits