PROENGR.IN

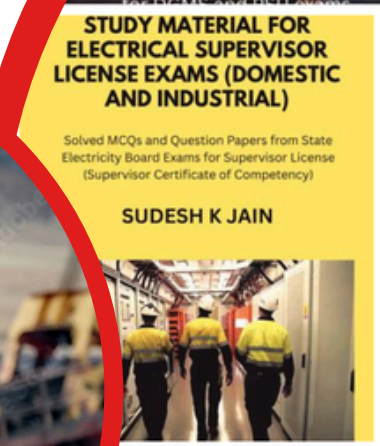
STUDY MATERIAL FOR MINE MANAGER CERTIFICATE & PSU EXAMS

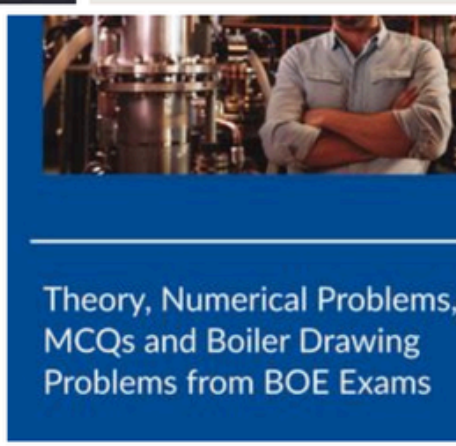
- Mine Management, Legislation & Safety
- Mine Machinery & Electricity
- Mine Ventilation And Environmental Hazards
- Winning & Working
- Mine Surveying

Amazon | Flipkart | Pothi

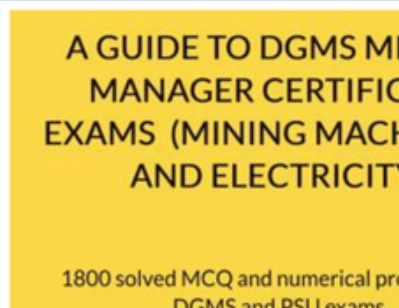












Govt. of India
Directorate- General of Mines Safety
Office of the Chairman, Board of Mining Examinations (Coal)

NOTIFICATION

GSR-

Dhanbad, the _____,2009

No. Board/Coal/_____/2009:- In pursuance of the provisions of Regulation 13(4) of the Coal Mines Regulations, 1957, the bye-laws for the conduct of examination and grant of Manager's Certificates of Competency so far as they relate to Subjects and Syllabus for Examination, for First Class Manager's Certificate (Appendix-I) and for Second Class Manager's Certificate (Appendix-II) is being substituted by the following:-

Certificate of Competency	Bye Law No.	Existing Provisions	Substituted Provisions
Managers Certificates of Competency	5	Subjects and syllabus for Examination:- (a) Winning and Working. (b) Mine Management, Legislation and General Safety. © Mine Ventilation, Explosions, Fires and Inundation. (d) Mine Surveying. (e) Mining Machinery.	Subjects and syllabus for Examination :- (a) Mine Management, Legislation and General Safety (b) Winning and Working. © Mine Ventilation, Explosions, Fires and Inundation. (d) Mining Machinery and Electricity. (e) Mine Surveying.

APPENDIX - I

SYLLABUS FOR THE EXAMINATION FOR FIRST CLASS MANAGER'S CERTIFICATE OF COMPETENCY

(Under Coal Mines Regulations, 1957)

(a) Mine Management; Legislation and General Safety

Mine Management:

Introduction: Evolution of management; theory and practice, principles of scientific management; elements of management function; planning; organisation and control; structure and design of organisation for mining enterprises.

Personal Management and Organisational behaviour: Selection; training and development of human resources for mining enterprises; leadership; study of traditional leader behaviour; autocratic; democratic and Laissez-Faire behaviours; conflict management; conflict in organisation; sources of conflict; dealing with conflict; organising for conflict resolution; conflict and growth; individual motivation; two way personal communication

Production Management: Determination of norms and standards of operations by work study; analysis of mine capacities and capability; production planning; scheduling and control; short term and long term planning; productivity; concepts and measurements; application of Ergonomics in mine operation.

Financial Management: Capital budgeting; techniques for mining project; project evaluation; pay back period and IRR; methods of cost analysis and cost control; break-even charts; working capital management; ERP(Enterprise Resource Planning).

Mining Environment: EIA (Environment Impact Assessment), EMP (Environment Management Plan), ETP(Effluent Treatment Plant), STP (Sewerage Treatment Plant) threat to environment from underground and surface mining, means of mitigation, treatment of pollutants, monitoring systems, water management; mine closure plan; R&R (rehabilitation and re-settlement).

Economic Impact of Mining: Economics of mining, effect on community – before, during and after mining; corporate social responsibility (CSR).

Materials Management for mining sector; ABC analysis, Inventory Management.

Industrial Accident: Study of human factors of industrial accidents; their causes and remedies.

Mine Legislation:

Health and Safety Laws: The Mines Act, 1952; Mines Rules, 1955; Coal Mine Regulation, 1957; Mines Rescue Rules, 1985; provisions of Indian Electricity Rules, 1956 applicable to mines; Mine Vocational Training Rules, 1966; other rules and legislation applicable to coal mines.

General Safety in Mines:

Safety in Mines: Duty of care; occupational hazards of mining; causes and prevention; accidents and their classification; accident statistics; frequency rate and severity rates; cause-wise analysis; basic causes of accident occurrence; investigations into accidents and accident reports; in-depth study into various causes of accidents; measures for improving safety in mines; TRAP (take responsibility in accident prevention); cost of accident; safety management system; contribution of human elements in mine safety; workers participation in safety management; ISO and safety audit; safety conferences; tripartite and bipartite committees; mine environment monitoring and control; role of information technology in safety management.

Risk Management: Theory and application, baseline, continuous and issue based risk assessment, risk management techniques and applications, means of managing (minimizing or eliminating) risk, computer application and simulations, manager's role in risk management, due diligence, application of risk assessment and risk management with reference to due diligence.

Disaster management; Emergency services, equipments and procedures, emergency control rooms, rescue and recovery; procedure and responsibilities, safety of persons engaged in emergency response, investigations and reports; assessment of damage, mine rescue; mine gases and their physiological effects; rescue equipments; resuscitation and reviving apparatus; selection and training for rescue work.

First aid and ambulance work.

Notified and occupational diseases; silicosis and pneumoconiosis; physiological aspects of breathing in dust laden atmosphere; dust sampling and sampling instruments; methods of counting and analysis; other mines diseases and their symptoms; prevention and treatment.

Lighting: general principles of artificial lighting; lighting standards and their assessment.

Sanitation and health in mines.

Safety related issues in coal beneficiation and transport.

(b) Winning and Working

Geology: Nature and occurrence of coal seams; description of Indian coalfields; application of geology to mining; geological structures; folds, faults, fractures, fissures etc.; boring through disturbed strata; bore hole survey; indicated and proved coal reserves; interpretation of geological maps.

Opening of coal seams: Legal requirement about outlets; siting; vertical shaft; inclines; shaft sinking and deepening; drift drivage; mechanised stone drifting; methods of sinking: mechanized sinking; in ordinary and water logged grounds, in running sand etc.; freezing, cementation and other special methods; shaft supports, temporary and permanent, tubings etc, recent developments.

Development and layout of mines including surface and underground arrangements; layout and development of shaft-top and pit-bottom and haulage arrangements.

Underground Mining Methods: Choice of methods of mining coal seams and factors affecting the same; statutory provisions.

Bord and Pillar method: Schemes of development; design of bord and pillar working; statutory provisions; selection of equipment for development – mechanised loaders, continuous miners etc.; preparatory arrangement for depillaring; statutory provision for depillaring; designing the system of pillar extraction with caving and stowing; mechanisation in depillaring operation; types of loading machines: continuous miners etc.; roof management; local fall and main fall; indications of roof weighting; air blasts and precautions against the same; precautions against fire and inundation during depillaring; multi-section and contiguous working; liquidation of developed pillars.

Longwall mining: Methods of driving gate roads; single and multiple heading gate roads; longwall face layout – advancing and retreating faces; orientation of longwall face; support system for longwall gate roads; powered supports; face transfer, operation of shearer and plough; roof management and hard roof management; periodic and main fall; design of high productive longwall panel; mini/short-wall mining; communication and telemonitoring.

Thick seam mining: Bord and pillar and longwall methods in multi-section; multi-slice methods; inclined slicing; horizontal slicing and cross slicing in ascending and descending orders; under winning methods; sublevel caving; integral caving; blasting gallery and descending shield methods; hydraulic mining; special methods of thick seam mining.

Other special methods of mining: Wide stall method; methods of mining thin seams; underground coal gasification, coal bed methane/ coal mine methane etc.

Opencast Mining: Opening of deposits and preparation for excavation; box cut; types; selection of site; formation of production benches; ripping; types of rippers; concept of rippability and cycle of operation; drilling; blast hole drills; performance parameters;

requirement of number of drills; blasting; blast design; factors influencing blast design; deep hole blasting; calculation of charge per hole; ground vibrations; secondary blasting and problems of blasting, side casting; surface miners; safety aspects.

Discontinuous/cyclic methods of excavation and transport; shovel dumper operation; applicability of electric shovel and hydraulic excavators; cycle time and productivity calculation; estimation of equipment fleet; dragline operation; side casting; side cast diagram; calculation of reach; cycle time; productivity calculation; bucket capacity requirement; scrapers; types; method of work; push pull operation etc.; bucket wheel excavator; operational methods (lateral block, half block and full block etc.); productivity calculation; continuous surface miner; operational methods (wide/full base method, wide/full bench, block mining, stepped cut, empty travel back, turn back and continuous mining methods); conveyors; shiftable and high angle conveyors; mode of operation etc.; OITDS (operator independent truck despatch system); in-pit crushing and strip-mining; opencast mining over developed coal seams; high-wall mining; safety aspects.

Application of concepts of Rock Mechanics for designing the methods of mining and strata control: Theories of ground movement and strata control; stress, strain – compressive and tensile, shear strength, uniaxial and tri-axial strength, Poisson's Ratio, Young's Modulus, convergence, elasticity, lithostatic and hydrostatic pressure; rock mass classifications, strength of stooks; shaft pillars; protection of surface structures; design and stability of structures in rock; design of support and reinforcement for underground excavation; support resistance, yielding and non yielding supports, dynamic and static loading, measuring instruments, consolidated and unconsolidated fills, rock bolts, cable bolts; latest developments in mine supports, economics of support design, subsidence; caving of rock mass; bumps; monitoring of rock mass performance; mechanics of rock fragmentation; slope stability and dump stability; dump management; roof management.

Development of safe explosives; permitted explosives; composition and testing of safe explosives; Milli-second detonators; alternatives of explosives. Use and safe handling of explosives in coal and stone drivages in gassy and non-gassy mines; blasting techniques and their relative efficiency, total cost concept.

Application of numerical modelling in mine design; application of computers in mine design and operational controls.

(c) Mine Ventilation, Explosions, Fires and Inundation

Composition of mine atmosphere: Mine gases; generation, properties and effects; sampling and analysis of mine air; methane content; methane drainage; flame safety lamp; methanometers and multi-gas detectors; gas chromatograph; methane layering; monitoring of different gases; telemonitoring; coal bed methane/coal mine methane.

Heat and humidity: Sources of heat in mines; geothermal gradient; heat flow in deep mines; effects of heat and humidity; psychometrics; computation of thermodynamic properties of mine air; basic modes of heat transfer in mines; methods of calculation of heat flow and temperature rise in mine airways; heat and moisture transfer in bord and

pillar and longwall workings; computation of heat load due to various machines e.g. belt conveyor, power pack, stage loader, lump breaker, armoured flexible conveyor, shearer etc. in longwall gate roads and face and road header, continuous miner and underground sub-stations etc. in the mine; air cooling and conditioning.

Air flow in mines: Laws of air flow; resistance of airways; resistance and splitting problems; equivalent orifice; flow control devices; permissible air velocities.

Natural ventilation: Seasonal variations; calculation of natural ventilation pressure; thermodynamic principles and other short-cut methods.

Mechanical ventilation: Theory of different fans; characteristics and suitability of fan; selection, testing and out put control; fans in series and parallel; reversal of air flow; fan drift, diffuser and evasee; booster and auxiliary fans; ventilation of headings and sinking shafts; standards of ventilation; ventilation calculations.

Ventilation planning: Ventilation layout; determination of size of shafts and airways; estimation of air quantity requirements; ventilation network analysis; Hardy Cross method of iterative analysis and application of linear theory; thermodynamic network analysis and computer application; application of numerical modelling; estimation of pressure requirement; ventilation survey; recent development in mine ventilation, ventilation plans.

Airborne dust: Generation, dispersion, measurement and control; suppression and treatment of coal dust; properties of stone dusts; sampling and analysis of coal dust.

Mine fires: Causes of mine fires, spontaneous combustion, mechanism and susceptibility indices, detection and prevention of spontaneous heating and mine fires; dealing with mine fires; sealing off fire-areas; build-up of extinctive atmosphere; pressure balancing; fire fighting organisation; gas ratios and their limitations; modified gas ratios; reopening of sealed off fire areas; fires in quarries over developed pillars; coal stack and waste dump fires.

Mine explosions: Firedamp and coal dust explosions; causes and prevention; stone dust barrier; water barrier and other methods.

Explosion in quarries over developed pillars.

Water gas explosion.

Inundation: Causes and prevention; precautions and techniques of approaching old waterlogged workings; safety boring apparatus; pattern of hole; design and construction of water dams; water lodgements; monsoon preparations, water danger plan.

Recovery of mines after explosions, fires and inundation and investigations, rescue and recovery in mines; rescue apparatus; organisation of rescue work; emergency preparedness and response system.

Illumination: Cap lamps; layout and organisation of lamp rooms; standards of illumination; photometry and illumination survey.

Risk Assessment and analysis with reference to mine environment, management of environmental risks.

(d) Mining Machinery and Electricity:

Theory of Machines: Machine design, different types of gears and drives, bearings, collars and joints, brakes and friction clutches, governors.

Heat engines, general outline of working principles of steam generators and auxiliary equipment. condensing plant, reciprocating steam engines, turbines, internal combustion engines, conduct of gas, oil and steam engine trials; mechanical efficiency of engines, measurement of indicated and brake horsepower.

Machine tools and work shop processes.

Wire ropes: Construction details, applications, mechanical properties, breaking load, factor of safety, bending factor, capacity factor, snap length; critical depth; inspection; examination and discarding criteria; rope capping and splicing.

Mine winders: Types and applications; components; shaft fittings; drums and sheaves; ropes and guides; drives and control systems; automatic contrivances; brakes; cage; skip; counter weight and suspension arrangement; duty cycle diagram; winder capacity and motor power calculations; equivalent mass of winder installation; safety devices; Installation; examination and testing of winding equipment, non destructive testing.

Underground machinery: Coal drills; jumbo drills; roof bolters; quad bolters; UDM; shearers; ploughs; AFC; road headers; dint headers; continuous miners; shuttle cars; SDLs; LHDs.

Material handling equipment in mines: Types, construction and operation; safety devices; maintenance and calculations for rope haulages; locomotives (tractive effort, draw bar pull, ideal gradient); conveyors systems (belt conveyor, chain conveyor, cable belt conveyor, high angle conveyor, shiftable belt conveyor, pipe conveyor); aerial rope ways; man riding systems; in-pit crushers; feeder breaker etc.; mine cars; track design and layout; super elevation; track fitting and safety appliances; self-acting inclines; coal handling plants; rail wagon loading plants; use of diesel equipment in underground coal mines, free steered vehicles.

Pumps: Types, Characteristics, motor power, capacity and calculations; laying of water mains; dealing with acid water; slurry, drainage; lodgements, storage, designs and layout of dams, sumps, pumping problems.

Opencast machinery: Construction, function and operation of blast hole drills; rippers; scrapers; shovels; draglines; dumpers; road graders; dozers; wheel loaders; bucket wheel excavators; spreaders; surface miners and their maintenance aspects.

Generation, transmission and utilisation of power; steam, compressed air; air compressors and auxiliary equipment; air turbines and air engines; efficiency of power, steam systems; safety aspects.

Maintenance Systems: Monitoring and reporting, tribology – corrosion, planned maintenance, Preventive, periodical and total maintenance system in mines. Condition based monitoring and related maintenance system.

Mine electrical engineering: Generation, Transmission and distribution of electrical power in mines; radial and ring-main distribution; power economics; industrial tariffs; power factor improvement; sub station arrangements; short transmission lines; cables; switch gears and protective devices; protective relays; circuit breakers; gate-end box; drill panel; field switch; trans-witch; symmetrical fault and circuit breaker rating; mine signalling; electrical drives and semiconductor controllers; selection of motors and starters; semi-conductor devices; principles of operation of thyristor controlled variable speed electrical drives; electrical breaking; earthing; flameproof enclosures and intrinsic safety; use of high voltage operational equipment in mines.

(e) Mine Surveying

Linear measurement: Instruments for measuring distance and ranging, units of measurement in surveying.

EDM: Principles of measurement; types, correction and selection of instrument.

Angular measurement: Prismatic compass; bearing of lines; local attraction; magnetic declination.

Dials; loose and fast needle surveying; plane table surveying and micro-optic alidade.

Theodolite: Modern micro-optic theodolites; measurement of horizontal and vertical angles; theodolite traversing; traverse calculation; computation of coordinates; adjustment of traverse; temporary and permanent adjustment; tacheometry.

Levelling: Levelling instruments; types of levelling; characteristics and uses of contours; methods of contouring; booking and reduction methods; shaft depth measurement; temporary and permanent adjustment of levels; problem solving.

Controlled survey: Triangulation; trilateration; application of GPS and Total Station in mine surveying.

Field astronomy: Astronomical terms; determination of true bearing by equal altitude method; Gyro theodolite; principle and determination of Gyro north; Astronomical triangle; conversion of time systems and precise determination of azimuth by astronomical methods.

Correlation: Methods of correlation surface and underground including Gyro-Laser combination.

Development surveys: Surveys of flat, moderately and steeply inclined and vertical workings; control of direction and gradient in drifts and roadways; traversing along steep working with or without auxiliary telescopes; 3D laser profiling of surfaces and bench walls.

Theory of errors and adjustments: Causes and classification of errors; indices of precision; laws of weight; propagation and adjustment of errors; adjustment of triangulation figures.

National grid: Map projection – Cassini, Lambert's polyconic and universal transfers mercator; transformation of coordinates.

Geodesy: Geod, spheroid and ellipsoid; geocentric, geodetic and astronomical coordinates; orthometric and dynamic heights.

Photogrammetry: Introduction; scale of a vertical photograph; photographs versus maps; application of photogrammetry and remote sensing in mining.

Area and volume calculation: Different methods and their limitations; earthwork and building estimation; laying out of rail curves and haul road curves, surface and underground.

Dip and strike problems; outcrop problems; borehole surveying and calculations.

Types of plans and their preparation, care, storage and preservation; legislation concerning mine plans and sections; duties and responsibilities of surveyors.

Application of computers in mine surveying and preparation of plans.

APPENDIX - II

SYLLABUS FOR THE EXAMINATION FOR SECOND CLASS MANAGER'S CERTIFICATE OF COMPETENCY
(Under Coal Mines Regulations, 1957)

(a) Mine Management; Legislation, and General Safety

Mine Management:

Introduction: Principles of scientific management; management functions; planning; organisation and control; structure of organisation for mining enterprises.

Personal Management: Selection; training and development of human resources for mining enterprises.

Production Management: Production planning; scheduling and control; short term and long term planning; productivity and its measurements.

Environmental Management: Mine environment monitoring and control; EMP (Environment Management Plan); mine closure plan; R&R (rehabilitation and re-settlement).

Mine Legislation:

Health and Safety Laws: The Mines Act, 1952; Mines Rules, 1955; Coal Mine Regulation, 1957; Mines Rescue Rules, 1985; Provisions of Indian Electricity Rules, 1956 applicable to mines; Vocational Training Rules, 1966; Other rules and legislation applicable to coal mines.

General Safety in Mines:

Safety in Mines: Causes and prevention of accidents and their classification; frequency rate and severity rates; cause-wise analysis; investigations into accidents and accident reports; in-depth study into various causes of accidents; measures for improving safety in mines; risk assessment and risk management; cost of accident; safety management system; human elements in mine safety; workers participation in safety management; ISO and safety audit; safety conferences; tripartite and bipartite committees.

Disaster management; rescue and recovery; mine rescue; mine gases and their physiological effects; rescue equipments; resuscitation and reviving apparatus; selection and training for rescue work.

First aid and ambulance work.

Notified and occupational diseases; silicosis and pneumoconiosis; physiological aspects of breathing in dust laden atmosphere; dust sampling and sampling instruments; methods

of counting and analysis; other mines diseases and their symptoms; prevention and treatment.

Lighting: general principles of artificial lighting; lighting standards and their assessment.

Sanitation and health in mines.

Safety related issues in coal beneficiation and transport.

(b) Winning and Working

Geology: Nature and occurrence of coal seams; description of Indian coalfields; geological features of coalfields; methods of boring; boring through disturbed strata; borehole survey; interpretation of geological maps.

Opening of coal seams: Shaft sinking and drift drivage; methods of sinking: mechanized sinking; in ordinary and water logged grounds and other special methods; shaft supports, temporary and permanent; mechanised stone drifting etc.

Development and layout of mines including surface and underground arrangements; layout and development of shaft-top, pit-bottom and haulage arrangements.

Underground Mining Methods: Choice of methods of mining coal seams and factors (depth, seam thickness, inclination etc.) affecting the same; statutory provisions.

Bord and Pillar method: Design of bord and pillar working; statutory provisions; mechanised loaders; continuous miners etc.; depillaring and applicable statutory provision; pillar extraction with caving and stowing; mechanisation in depillaring; local fall and main fall; indications of roof weighting; air blasts and precautions against the same; precautions against fire and inundation; multi-section and contiguous working.

Longwall mining: Methods of driving single and multiple heading gate roads; orientation of longwall face; advancing and retreating faces; support system for longwall gate roads; powered supports; face transfer, operation of shearer and plough; periodic and main fall; mini/short-wall mining; communication and telemonitoring.

Thick seam mining: Bord and pillar and longwall methods in multi-section; multi-slice methods; inclined slicing; horizontal slicing and cross slicing in ascending and descending orders; under winning methods; sublevel caving; integral caving; blasting gallery and descending shield methods; hydraulic mining; special methods of thick seam mining.

Other special methods of mining: Wide stall method; methods of mining thin seams; underground coal gasification, coal bed methane/ coal mine methane etc.

Opencast Mining: Opening of deposits and preparation for excavation; box cut, types; site selection; formation of benches; rippability; types of rippers; cycle of operation;

drilling; blast hole drills; performance parameters; requirement of number of drills; blasting; blast design; factors influencing blast design; deep hole blasting; calculation of charge per hole; ground vibrations; secondary blasting and related problems; surface miners; safety aspects.

Discontinuous/cyclic methods of excavation and transport; shovel dumper operation; electric shovel and hydraulic excavators; cycle time and productivity calculation; estimation of equipment fleet; dragline operation; side casting; calculation of reach; cycle time; productivity calculation; bucket capacity requirement; scrapers; bucket wheel excavator (lateral block, half block and full block method etc.); productivity calculation; continuous surface miner (wide/full base, wide/full bench, block mining, stepped cut, empty travel back, turn back and continuous mining methods); conveyors; shiftable and high angle conveyors; in-pit crushing and strip-mining; opencast mining over developed coal seams; highwall mining; safety aspects.

Application of concepts of Rock Mechanics for designing the methods of mining and strata control: Theories of ground movement and strata control; strength of stooks; shaft pillars; protection of surface structures; design and stability of structures in rock; rock mass rating; design of support and reinforcement for underground excavation; consolidated and unconsolidated fills, rock bolts, cable bolts; subsidence; caving of rock mass; bumps; monitoring of rock mass performance; mechanics of rock fragmentation; slope stability and dump stability; dump management; roof management.

Use and safe handling of explosives; blasting techniques and their relative efficiency, total cost concept.

(c) Mine Ventilation, Explosions, Fires and Inundation

Composition of mine atmosphere: Mine gases; generation, properties and effects; sampling and analysis of mine air; occurrence, properties, characteristics, detection and measurement of firedamp; methane drainage; flame safety lamp; methanometers and multi-gas detectors; gas chromatograph; methane layering; monitoring of different of gases; telemonitoring, coal bed methane/coal mine methane.

Flame safety lamps and their design; use and maintenance; testing of safety lamps; lamp houses and organizations.

Heat and humidity: Sources of heat in mines; geothermal gradient; effects of heat and humidity; heat transfer in bord and pillar and longwall workings; methods of calculation of heat flow and temperature rise; heat load due to various machines; air cooling and conditioning.

Air flow in mines: Laws of air flow; resistance of airways; resistance and splitting problems; equivalent orifice; flow control devices; permissible air velocities.

Natural ventilation: Seasonal variations; calculation of natural ventilation pressure.

Mechanical ventilation: Mechanical ventilators; characteristics and selection; testing and out put control; fans in series and parallel; reversal of air flow; fan drift; diffuser and evasee; booster and auxiliary fans; standards of ventilation; ventilation calculations.

Ventilation planning: Ventilation layout; determination of size of shafts and airways; estimation of air quantity requirements; ventilation network analysis; thermodynamic network analysis and computer application; estimation of pressure requirement; ventilation survey; recent developments in mine ventilation, ventilation plans.

Airborne dust: Generation, dispersion, measurement and control; suppression and treatment of coal dust; properties of stone dusts; sampling and analysis of coal dust.

Mine fires: Causes of mine fires; spontaneous combustion; mechanism; susceptibility indices (crossing and ignition point temperatures); wet oxidation potential; factors affecting spontaneous combustion; detection and prevention; dealing with mine fires; sealing off fire-areas; build-up of extinctive atmosphere; pressure balancing; fire fighting organisation; gas ratios and their limitations; modified gas ratios; reopening of sealed off fire areas; fires in quarries over developed pillars; coal stack and waste dump fires.

Mine explosions: Inflammability of firedamp and coal dust; firedamp and coal dust explosions; causes and prevention; stone dust barrier; water barrier and other methods.

Explosion in quarries over developed pillars.

Water gas explosion.

Inundation: Causes and prevention; precautions and techniques of approaching old waterlogged workings; safety boring apparatus; pattern of hole; design and construction of water dams; water lodgements; monsoon preparations, water danger plan.

Recovery of mines after explosions, fires and inundation and investigations, rescue and recovery in mines; rescue apparatus; organisation of rescue work; emergency preparedness and response system; emergency organisation.

Illumination: Cap lamps; layout and organisation of lamp rooms; standards of illumination; photometry and illumination survey.

(d) Mining Machinery and Electricity:

Theory of Machines: Machine design, different types of gears and drives, bearings, collars and joints, brakes and friction clutches, governors.

Heat engines, general outline of working principles of steam generators and auxiliary equipment. condensing plant, reciprocating steam engines, turbines, internal combustion engines, conduct of gas, oil and steam engine trials; mechanical efficiency of engines, measurement of indicated and brake horsepower.

Machine tools and work shop processes.

Wire ropes: Construction details, applications, mechanical properties, breaking load, factor of safety, bending factor, capacity factor, snap length; critical depth; inspection; examination and discarding criteria; rope capping and splicing.

Mine winders: Types and applications; components; shaft fittings; drums and sheaves; ropes and guides; drives and control systems; automatic contrivances; brakes; cage; skip; counter weight and suspension arrangement; duty cycle diagram; winder capacity and motor power calculations; equivalent mass of winder installation; safety devices; Installation; examination and testing of winding equipment, non destructive testing.

Underground machinery: Coal drills; jumbo drills; roof bolters; quad bolters; UDM; shearers; ploughs; AFC; road headers; dint headers; continuous miners; shuttle cars; SDLs; LHDs.

Material handling equipment in mines: Types, construction, operation; safety devices; maintenance and calculations of rope haulages; locomotives (tractive effort, draw bar pull, ideal gradient); conveyors (belt, chain, cable belt, high angle, shiftable and pipe conveyor); aerial rope ways; man riding systems; in-pit crushers; feeder breaker etc.; mine cars; track; super elevation; track fitting and safety appliances; self acting inclines; coal handling plants; rail wagon loading plants; use of diesel equipment in underground, free steered vehicles.

Pumps: Types, characteristics, motor power, capacity and calculations; laying of water mains; dealing with acid water; slurry, drainage; lodgements, storage, designs and layout of dams, sumps, pumping problems.

Opencast machinery: Construction, function and operation of blast hole drills; rippers; scrapers; shovels; draglines; dumpers; road graders; dozers; wheel loaders; bucket wheel excavators; spreaders; surface miners and their maintenance aspects.

Generation, transmission and utilisation of steam and compressed air; safety aspects.

Preventive, periodical and total maintenance system in mines.

Mine electrical engineering: Generation, transmission and distribution of electrical power in mines; radial and ring-main distribution; sub station arrangements; short transmission lines; cables; switch gears and protective devices; protective relays; circuit breakers; gate-end box; drill panel; field switch; trans-witch; symmetrical fault and circuit breaker rating; mine signalling; power factor improvement; electrical drives and semiconductor controllers; selection of motors and starters; semi-conductor devices; principles of operation of thyristor controlled variable speed electrical drives; electrical braking; earthing; flameproof enclosures and intrinsic safety; use of high voltage operational equipment in mines.

(e) Mine Surveying

Linear measurement: Instrument for measuring distance and ranging, units of measurements.

EDM: Principles of measurement, types, correction, selection of instrument.

Angular measurement: Prismatic compass; bearing of lines; local attraction; magnetic declination.

Theodolite: Modern micro-optic theodolites; measurement of horizontal and vertical angles; theodolite traversing; traverse calculation; computation of coordinates; adjustment of traverse; temporary and permanent adjustment; Gyro theodolite; principle and determination of Gyro north; determination of true bearing by equal altitude method; tacheometry.

Levelling: Levelling instruments; types of levelling; characteristics and uses of contours, methods of contouring; booking and reduction methods; shaft depth measurement; temporary and permanent adjustment of levels.

Controlled survey: Triangulation; trilateration; application of GPS and Total Station in mine surveying.

Field astronomy: Astronomical terms; determination of true bearing by equal altitude method; Gyro theodolite; principle and determination of Gyro north; Astronomical triangle; conversion of time systems and precise determination of azimuth by astronomical methods.

Correlation: Methods of correlation surface and underground including Gyro-Laser combination.

Development surveys: Surveys of flat, moderately and steeply inclined and vertical workings; control of direction and gradient in drifts and roadways; traversing along steep working with or without auxiliary telescopes.

Theory of errors and adjustments: Causes and classification of errors; indices of precision; laws of weight; propagation and adjustment of errors; adjustment of triangulation figures.

National grid: Map projection – Cassini; Lambert's polyconic and universal transfers mercator; transformation of coordinates.

Area and volume calculation: Different methods and their limitations; earthwork and building estimation; laying out of rail curves, surface and underground.

Dip and strike problems; outcrop problems; borehole surveying and calculations.

Types of plans and their preparation, care, storage and preservation; legislation concerning mine plans and sections; duties and responsibilities of surveyors.

Application of computers in mine surveying and preparation of plans.

(M M Sharma)
Director General of Mines Safety &
Chairman, Board of Mining Examination (Coal).