PROENGR.IN

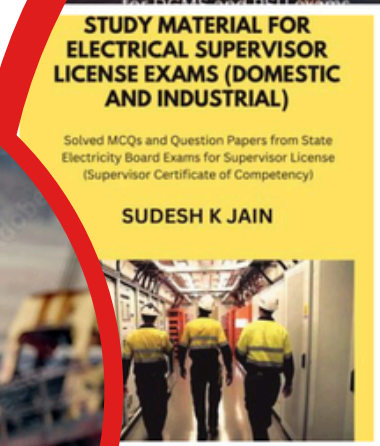
STUDY MATERIAL FOR MINE MANAGER CERTIFICATE & PSU EXAMS

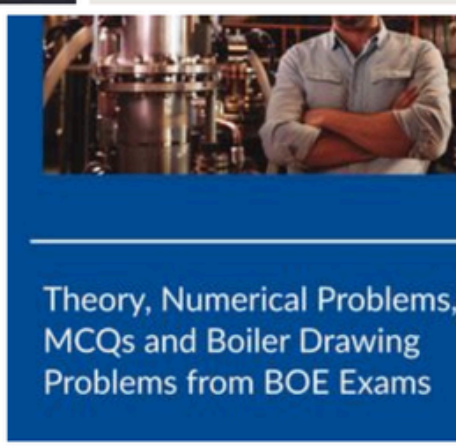
- Mine Management, Legislation & Safety
- Mine Machinery & Electricity
- Mine Ventilation And Environmental Hazards
- Winning & Working
- Mine Surveying

Amazon | Flipkart | Pothi

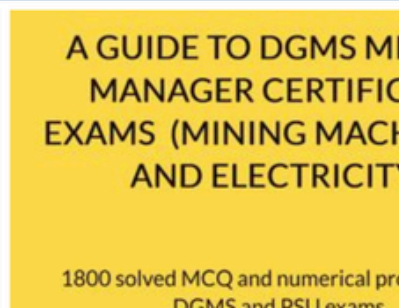












MINISTRY OF LABOUR AND EMPLOYMENT

(DIRECTORATE GENERAL OF MINES SAFETY)

NOTIFICATION

Dhanbad, the 11th August, 2021

G.S.R. 560(E).—In pursuance of the provisions of Regulation 13 (1) and 13 (4) of the Metalliferous Mines Regulations, 1961, the Bye-laws for the grant of certificates on exemption basis and for conduct of examinations for Manager's Certificates of Competency, are stipulated by the Board as follows:-

1.0 **Practical Experience:** -For purpose of Regulation 16(2) (a) following practical experience shall be approved:

1.1 Period, Nature & Details of Practical Experience:

1.1.1 First ClassManager's Certificate-Examination:

Qualification	**Period, Nature & details of Practical experience.**
Degree in Mining Engineering or other equivalent qualification approved in that behalf by the Central Government OR Diplomain Mining or Miningeng ineering or other equivalent qualification approvedin that behalf by the Central Government OR Senior Secondary School Examination or Intermediate examination or its equivalent from a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering, Applied Geology, Civil, Mechanical or Electrical Engineering, or other equivalent qualification approved in that behalf by the Central Government.	Not less than One year of practical experience in a Metalliferous mine having below ground workings after – Possession of Second Class Manager's Certificate, in acapacity requiring– The possession of Second Class Manager's/Foreman's Certificate
Diplomain Miningor Mining engineering or other equivalent qualification approved in that behalf by the Central Government	Not less than Four year of practical experience in a Metalliferous mine having below ground workings after – Possession of Foreman's Certificate, in acapacity requiring– The possession of/Foreman's/Mate's Certificate
Senior Secondary School Examination or Intermediate examinationor its equivalent from a recognized Board or University or Diplomaor Degree in any subject other than Mining Engineering, Applied Geology, Civil, Mechanical or Electrical Engineering, or other equivalent qualification approved in that behalf by the Central Government.	Not less than Three year of practical experience in a Metalliferous mine having below ground workings after – Possession of Foreman's/ Mate's Certificate, in acapacity requiring– the possession of Foreman's/Mate's Certificate

1.1.2 Second Class Manager's Certificate-Exemption:

Qualification	**Period, Nature & details of Practical experience.**
Degree in Mining Engineering or other equivalent qualification approved in that behalf by the Central Government	Not less than One year of practical experience in a Metalliferous mine having below ground workings after possession of the requisiteac ademic qualification.

1.1.3 Second Class Manager's Certificate- Examination:

Qualification	**Period, Nature & details ofPracticalexperience.**
Diploma in Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government	Not less than three years of practical experience in a Metalliferous mine having belowground working after– Possession of Foreman'sCertificate, In acapacity requiring– The possession of Foreman's Certificate or Mate's Certificate
Senior Secondary School Examination or Intermediate examinationor its equivalent from a recognized Board or University or Diplomaor Degree in any subject other than Mining Engineering, Applied Geology, Civil, Mechanical or Electrical Engineering, or other equivalent qualification approved in that behalf by the Central Government.	Not less than two years of practical experience in a Metalliferous mine having below ground working after – possession of Foreman's/ Mate's Certificate, in a capacity requiring – The possession of Foreman's Certificate or Mate's Certificate.

1.1.4 First Class Manager's Certificate (Restricted to mines having opencast workings only)- Examination:

Qualification	**Period, Nature & details of Practical experience.**
Degree in Mining Engineering or other equivalent qualification approved in that behalf by the Central Government OR Diploma in Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government OR Senior Secondary School Examination or Intermediate examinationor its equivalent from a recognized Board or University or Diplomaor Degree in any subject other than Mining Engineering, Applied Geology, Civil, Mechanical or Electrical Engineering, or other equivalent qualification approved in that behalf by the Central Government.	Not less than One year of practical experience in a Metalliferous mine having below groundor opencast workings after – Possession of Second Class Manager's Certificate, (including Certificate which is Restricted to mines having opencast workings only) in acapacity requiring– The possession of Second Class Manager's/ Foreman's Certificate (including Certificate which is Restricted to mines having opencast workings only)
Diploma in Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government	Not less than Four year of practical experience in a Metalliferous mine having below ground or opencast workings after – Possession of Foreman's Certificate, (including Certificate which is Restricted to mines having opencast workings only) in acapacity requiring– The possession of/Foreman's /Mate's Certificate ,(including Certificate which is Restricted to mines having opencast working sonly)
Senior Secondary School Examination or Intermediate examinationor its equivalent from a recognized Board or University or Diplomaor Degree in any subject other than Mining Engineering, Applied Geology, Civil, Mechanical or Electrical Engineering, or othere quivalent qualification approved in that behalf by the Central Government.	Not less than Three year of practical experience in a Metalliferous mine having below ground or opencast workings after – Possession of Foreman's/ Mate's Certificate, ,(including Certificate whic his Restricted to mines having opencast workings only) in acapacity requiring– The possession of Foreman's/Mate's Certificate,

	(including Certificate which is Restricted to mines having opencast workings only)

1.1.5 Second Class Manager's Certificate (Restricted to mines having opencast workings only)- Exemption:

Qualification	**Period, Nature&detailsofPracticalexperience.**
Degree in Mining Engineering orother equivalent qualification approved in that behalf by the Central Government	Not less than One year of practical experience in a Metalliferous mine having belowground or opencast workings after possession of the requisite academic qualification.

1.1.6 Second Class Manager's Certificate (Restricted to mines having opencast workings only)-Examination:

Qualification	**Period, Nature&detailsofPracticalexperience.**
Diplomain Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government	Not less than three years of practical experience in a Metalliferous mine having belowground or opencast working after– Possession of Foreman's Certificate, (including Certificate which is Restricted to mines having opencast workings only) in a capacity requiring– The possession of Foreman's Certificate or Mate's Certificate (including Certificate which is Restricted to mines having opencast workings only)
Senior Secondary School Examination or Intermediate examination or its equivalent from a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering, Applied Geology, Civil, Mechanical or Electrical Engineering, or other equivalent qualification approved in that behalf by the Central Government.	Not less than two years of practical experience in a Metalliferous mine having belowground or opencast working after– Possession of Foreman's/Mate's Certificate, (including Certificate which is Restricted to mines having opencast workings only) in a capacity requiring– The possession of Foreman's Certificate or Mate's Certificate (including Certificate which is Restricted to mines having opencast workings only)

Note: Subject to successfully passing the examinations as detailed under Clauses 10.1, 10.2, 10.3 and 10.4 for Manager's Certificate of Competency examinations.

1.2 Practical experience, for a period of less than one week in a mine shall not be considered.

1.3 Every certificate of practical experience should containprecise information about the capacity in which the candidate worked, the nature of work done, and the date of commencement and termination of experience at each mine.No certificate of practical experience shall be considered unless it is granted by the Manager of the mine. Every suchCertificate shall also carry the signature of the applicantattested by the Manager. Where a person working as the Manager of a minerequiresapracticalexperience, it shall be considered only ifitisgranted by the Agent or Owner of the mine. No Certificate of practical experience shall be accepted unlessitisina form prescribed by the Board.

1.4 The certificate of experience must be signed & dated by the Manager with seal of office and not by ProductionManager/Ventilation Officer/Senior Manager/Safety Officer etc. Capacity, nature of work done, place, experience anddates of commencement and termination of training must be clearly indicated. Candidate must sign at the specificplace.

1.5 Practical experience gained outside duty hours is not acceptable.

1.6 Experience obtained in actual mining operations under any designation (supervisor, Assistant Supervisor, Engineer, Assistant Foreman, Mate, Assistant Mate, worker, trainee, etc.) after possessing degree/diploma in mining, may be treated as equivalent to PGPT/ PDPT etc.

2.0 **Type of Examination:**

2.1 The examination for each subject shall consist of a Computer Based Test (CBT) of three hours duration.

2.2 Questions for each subject shall be submitted to the Board. The Board may ratify the questions, if required.

2.3 Subject Marks: - Every subject shall carry maximum of 150 marks.

2.4 In order to pass the examination a candidate must obtain not less than 50% of the maximum marks in each subject in Computer Based Test (i.e. at least 75 out of 150).

3.0 **Identity and conduct of Examinees:**

3.1 While appearing in an examination, every candidate shall conduct himself/ herself as required by the Secretary.

3.2 Electronic gadgets like mobiles, lap-tops etc. Shall not be inpossession of the candidates in the examination hall.

4.0 **Penalty for Misconduct:**

4.1 Any candidate who submits false certificate or counterfeits certificate or makes false declaration or adopts unfairmeans during the examination, may be disqualified by the Board and also debarred from appearing at any subsequentexamination foraspecifiedperiod dependinguponthefactsofthe case.

4.2 If a candidate who has been declared successful in any examination for the grant of a certificate or who has beengranted a certificate is found to have submitted a false certificate, or to have counterfeited a certificate or to have made false declaration, the Board maycancel his/ her result or withdraw the certificate issued to him, as the case maybe.

5.0 **Declaration of Results:** The final result of the examinations as approved by the Board, shall be announced by the Secretary on a date fixed by the Board.

6.0 **Frequency of Examinations:** The examinations shall be held once in a year, as far as practicable.

7.0 **Applications to be supported by Original Certificates, etc.:** No application shall be considered unless it is supported by scanned copy of all required original certificates for qualifications, practical experience, age and is accompanied by evidence that the prescribed fee has been paid. The original certificates and their self-attested copies shall be submitted by the candidate upon passing the said examination.

8.0 **Rules governing the conduct of Computer Based Test (CBT):**

8.1 No candidate shall be permitted to attend the CBT once the CBT has commenced.

8.2 Be foreenteringthe CBT hall, every candidate shall leaveall books, notesand paper etc. outside.

8.3 Every candidate shall be required to signina Register/Sheet in which his roll number/ID would be recorded.

8.4 Any candidate esiringtoconsulttheexaminerorinvigilatororanyotherassistantsrequiringanyassistanceshouldstand inhisseat to draw attention but should not call out.

8.5 Any candidate speaking to any other candidate, or consulting any book or notes, or using paper other than that supplied by the Board or using any other unfair means or acting in a manner considered improper by the examiner shall be liable to be disqualified.

8.6 No candidate shall leavethe examination hall before the expiry of onehour after the commencement of the examination.

8.7 When candidate has completed the answer to the questions or when the time allowed for answering the questions haselapsed, or when a candidate has been disqualified under Clause No.8.5, hemustatonce leave the Examination Hall.

9.0 **Appointment of Examiners:**

9.1 Question banks shall be prepared as objective type Multiple Choice Questions (MCQ), as far as practicable by the Academicians / Scientists conversant with the concerned subjects from reputed institutes and / or Mining Engineers holding First Class Managers' Certificate (including Certificate which is restricted to mines having opencast workings only) and /or an Inspectors of Mines appointed by the Board.

9.2 Except in an emergency, no member of the Board shall act as an examiner.

10.0 **Subjects, Syllabus and Fees for Examination:**

10.1 The candidate for First Class Manager's Certificate shall be examined as follows:

S. No.	Qualification	Subject in which required Toappear	Syllabus
1	Degree in Mining Engineering or other equivalent qualification approved in that behalf by the Central Government	Mine Management, Legislation and General Safety.	**ANNEXURE-I**
2	Diploma in Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government; possessing Second Class Manager's Certificate	1.Mine Management, Legislation and General Safety. 2.Winning and Working 3. Mine Ventilation.	
3	Senior Secondary School Examination or Intermediate examination or its equivalent from a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering or other equivalent qualification approved in that behalf by the Central Government; possessing Second Class Manager's Certificate		
4	Diploma in Mining or Miningeng ineering or other equivalent qualification approved in that behalf by the Central Government	1. Mine Management, Legislation and General Safety 2. Winning and Working 3. Mine Ventilation 4. Mining Machinery 5. Mine Surveying	
5	Senior Secondary School Examination or Intermediate examination or its equivalent from a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering or other equivalent qualification approved in that behalf by the Central Government.		

10.2 The candidate for Second Class Manager's Certificate shall be examined as follows:

S.No.	Qualification	Subject in which required to appear	Syllabus
1	Degree in Mining Engineering or other equivalent qualification approved in that behalf by the Central Government	NIL	NIL
2	Diploma in Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government	Mine Management, Legislation and General Safety.	**ANNEXURE-II**
3	Senior Secondary School Examination or Intermediate examination or its equivalent from a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering or other equivalent qualification approved in that behalf by the Central Government.	1.Mine Management,Legislation and General Safety 2.WinningandWorking 3.MineVentilation 4.MiningMachinery 5.MineSurveying	

10.3 The candidate for First Class Manager's Certificate (Restricted to mines having opencast workings only) shall be examined as follows:

S. No.	Qualification	Subject in which required To appear	Syllabus
1	Degree in Mining Engineering or other equivalent qualification approved in that behalf by the Central Government	Mine Management, Legislation and General Safety.	**ANNEXURE-III**

2	Diplomain Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government; possessing Second Class Manager's Certificate (including Certificate which is Restricted to mines having opencast workings only)	1. Mine Management, Legislation and General Safety. 2.Winning andWorking	
3	Senior Secondary School Examination or Intermediate examination or its equivalent from a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering or other equivalent qualification approved in that behalf by the Central Government; possessing Second Class Manager's Certificate (including Certificate which is Restricted to mines having opencast workings only)		
4	Diploma in Mining or Mining engineering or other equivalent qualification approved in that behalf by the Central Government	1. Mine Management, Legislation and General Safety 2. WinningandWorking 3. MiningMachinery 4. MineSurveying	
5	Senior Secondary School Examination or Intermediate examination or its equivalent from a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering or other equivalent qualification approved in that be half by the Central Government.		

10.4 The candidate for Second Class Manager's Certificate (Restricted to mines having opencast workings only) shall be examined as follows:

S. No.	Qualification	Subject in which required to appear	Syllabus
1	Degree in Mining Engineering or other equivalent qualification approved in that behalf by the Central Government	NIL	NIL
2	Diploma in Mining or Miningeng ineering or other equivalent qualification approved in that behalf by the Central Government	Mine Management, Legislation and General Safety.	ANNEXURE-IV
3	Senior Secondary School Examination or Intermediate examination or its equivalentfrom a recognized Board or University or Diploma or Degree in any subject other than Mining Engineering or other equivalent qualification approved in that behalf by the Central Government.	1. Mine Management, Legislation and General Safety. 2. Winningand Working. 3. Mine Surveying. 4. Mining Machinery	

10.5 Fees to be Paid: The fees to be paid along with the application for grant of First Class Manager's Certificate isRupees One Hundred (Rs. 100 /-) and Second Class Manager's Certificate is Rupees Seventy Five(Rs. 75/-).

11.0 **SavingClauses:** Board may take decision on any matter, not specified under the above bye-laws, which may be brought to it for disposal.

12.0 If there is any variation or doubt between English and Hindi versions of Bye-laws, then English version of Bye-lawswill prevail overthe Hindiversion.

ANNEXURE–I

SYLLABUS FOR EXAMINATION FOR FIRST CLASS MANAGER'S CERTIFICATE

(Under Metalliferous Mines Regulations, 1961)

(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; organization and control; structure and design of organization for mining enterprises.

Personal Management and Organizational behavior Selection: 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 organization; sources of conflict; dealing with conflict; organizing 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 evaluation; payback period and IRR; methods of cost analysis and cost control; break-even charts; working capital management; ERP (Enterprise Resources 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). RFCTLARR Act, 2013 and laws related to forest land. Technical and biological reclamation and top soil management.

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.

LEGISLATION:-

Health and Safety Laws: The Mines Act, 1952; Mines Rules 1955, Metalliferous Mine Regulation, 1961, Mines Rescue Rules, 1985, provisions of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 applicable to mines; Mine Vocational Training Rules, 1966, other rules and legislation as may be or become applicable to Metalliferous mines.

GENERAL SAFETY:-

Safety in Mines: Duty of Care, Occupational hazards of mining, causes and prevention of accidents and their classification; accident statistics; frequency rate and severity rates; cause-wise analysis, basic causes of accident occurrence; investigation into accidents and accident report; in-depth study into various causes of accidents, measures for improving safety in mines; TRAP (take responsibility in accident prevention); cost of accident; SMP (Safety Management Plan); Elements of SMP, Preparation of SMP, Standard Operating Procedure (SOP) and Hazard Management Plans, dealing with accidents and emergencies in opencast mines, Causes of accident or incident,

Accident Investigation methods and steps, Accident / Incident reporting, contribution of human elements in mine safety,

Workers participation in safety management;

ISO and safety audit; safety conferences; tripartite and bipartite committees;

Role of information technology in safety management.

Risk Management: Theory and application, baseline, continuous and issue based risk assessment, how they are applied to technical areas, hazard identification, risk assessment techniques, Work Place Risk Assessment and Control (WRAC), Job Safety Analysis (JSA), Risk Matrix, Risk Management Options, Hierarchy of controls, Control Effectiveness, 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, Concept of Triggered Action Response Plan (TARP).

Airbone dust:- Generation, dispersion, measurement and control; suppression and treatment of mine dust; sampling and analysis of mine dust, Hazards due to dust in mines.

Mine fires:- Cause of mine fires, dealing with mine fires; firefighting organization; fires in quarries over developed pillars; Ore stack and waste dump fires, Hazards due to extraction of developed pillars, its mitigation, Hazards due to extraction of fiery seam or hot strata.

Inrush of water: Hazards and risk of mining operations, surface and underground, near water bodies or unconsolidated mass and its mitigation

Failure of Benches and Dumps: Strata management. Hazards and risks associated with Bench and Dump stability.

Hazards due to Extreme weather condition in opencast mines and its mitigation

Occupational hazards in mining and precautions

Biological Hazards, Chemical Hazards

Working at heights

Mine Gases: Generation, Properties and Effects, Detection of Mine Gases, Methanometers and Multi Gas Detectors, Gas Chromotograph, Flame Safety Lamps

Mine explosions: Cause of mine explosion, preventive measures and dealing with mine Explosions.

Disaster management: Crisis Management Plan (CMP), 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

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; preventions and treatment.

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

Sanitation and health in mines

Safety related issues in Crushing, Mineral/Overburden handling and transport system.

(b) <u>WINNING AND WORKING</u>

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

Opening of Mineral deposit: 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.

Developments 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 stoping and factors (depth, thickness, inclination, etc.) affecting the same;methods of development,stone drifting and statutory provisions.

Opencast Mining: Opening of mineral deposit and preparation for excavation; box cut, types; selection of site; Layout of Opencast mine, parameters, formation of production benches; ripping; types of rippers; cycle of operation; Construction of Haul roads and ramps, width, super elevation / camber, central bund, side bund, slope, base, sub-base, surface, Surface friction, materials required, drainage, curve, visibility, machines to be used, maintenance, monitoring, Haul road crossings, T-junction, tri-junction, four-way crossings, parameters, Parking of HEMM, parking of dump trucks, GO-line design, Shelter construction, view point construction.

Watering of mine roads for dust suppression, methods to be used, hazards due to overwatering, type of water spraying, spot or strip watering.

Drilling; blast hole drills; performance parameters; requirement of number of drills; blasting; use and safe handling of explosives, blasting techniques in stoping and development; blast design; factors influencing blast design; deep hold blasting; calculation of charge per hole; ground vibration; secondary blasting and problems of blasting; environment friendly non-blasting techniques; safety aspects. Permitted explosives.

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; continuous Surface Miner - operational methods(wide/full base methods, 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 dispatch system); in-pit crushing and strip-mining; safety aspects.

Construction of Haul roads and ramps: width, super elevation / camber, central bund, side bund, slope, base, sub-base, surface, Surface friction, materials required, drainage, curve, visibility, machines to be used, maintenance, monitoring, Haul road crossings, T-junction, tri-junction, four-way crossings, parameters, Parking of HEMM, parking of dump trucks, GO-line design, Shelter construction, view point construction.

Watering of mine roads for dust suppression, methods to be used, hazards due to overwatering, type of water spraying, spot or strip watering.

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 classification, strength of stooks; shaft pillar; protection of surface structures; design and stability of structures in rock; rock mass rating, design of support and reinforcement for underground excavations and open pits, support resistance, yielding and non-yielding supports, dynamic and static loading, measuring instruments, consolidated and unconsolidated fills, rock bolts, cable bolts, wire mesh, latest developments in mine supports, economics of support design, subsidence; caving of rock mass; bumps; monitoring of rock mass performance; roof management, mechanics of rock fragmentation; monitoring of rock mass performance, Types of bench and dump slope failures, Theories of ground movement and strata control, ; Dump types, internal and out of pit dumps, Dump construction, size, shape, Site selection and preparation for dumping, Methods of dumping, machines required for dump construction, consolidated and unconsolidated dumps, slope stability; slope angle, benches, berms, factors affecting slope stability, design criteria and monitoring systems; dump stability; dump management.

Danger from different sources of water; precautions to prevent inundation, siltation, bench and dump failures; designing drainage system, calculation of catchment area, sump and pump capacity, water dams, retaining walls, siltation ponds, gabion walls, water danger plans

Application of numerical modeling in mine design, application of computers in mine design and operational controls.

(c) MINE VENTILATION

Composition of mine atmosphere: Mine gases - generation, properties and effects; sampling and analysis of mine air; flame safety lamp; gas detectors; gas chromatograph; monitoring of different gases; telemonitoring.

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; 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 output control; fans in series and parallel; reversal of air flow; fan drift, diffuser and evasee; booster and auxiliary fans; ventilation of heading and sinking shafts; standards of ventilation; ventilation calculation.

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

Airborne dust: Generation, dispersion, measurement and control; suppression and treatment of dust; sampling and analysis of dust; physiological effect of dust.

Mine fires: Cause of mine fires, dealing with mine fires; fire fighting organization; fires in quarries; ore stack and waste dump fires.

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

Rescue and Recovery: Rescue and recovery in mines - rescue apparatus; organization of rescue work; investigation, emergency preparedness and response system; emergency organization; recovery of mine after explosion, fires and inundation.

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

Risk Management: Risk assessment and analysis with reference to mine environment, management of environmental risks.

(d) MINING MACHINERY

Strength of materials; Applied mechanics; Fluid mechanics.

Theory of Machines: Machine design, different types of gears and drives, bearing, 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 trial; mechanical efficiency of engines, measurement of indicated and brake horsepower.

Machine tools and workshop 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 fitting; 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, nondestructive testing.

Underground machinery: Jack hammer drills; jumbo drills; roof bolters;; LHDs(Electric or diesel),pnumetic loaders, low profile dump truck (LPDT),service vehicles,man transport vehicles,road headers etc.

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, high angle conveyor, shiftable belt conveyor, pipe conveyor); scraper winches, aerial rope-ways, communication equipment, man riding systems; in-pit crushers, feeder breaker etc., EOT cranes (electric overhead travel) and other cranes, hydraulic lifter, tyre handler, track design and layout; super elevation; track fitting and safety appliances; self acting inclines; rail wagon loading; plants; use of diesel equipments in underground 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(electric and hydraulic): Constructions, function and operation of blast hole drills, rippers, scrapers, shovels; dumpers, Surface Miners, road graders, dozers, wheel loaders; rock breakers and their maintenance aspects, water-trucks, In-pit crushing conveying (IPCC).

Generation, transmission and utilization of Power, Steam and compressed air: Air compressor 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 systems 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; transwitch; symmetrical fault and circuit breaker rating; mine signaling; electrical drives and semiconductor controllers; selection of motors and starters; semiconductor 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.

Generation, transmission and utilization of power, steam, electricity and compressed air in mines; safety aspects.

Automation in mines:- Armchair mining (tele-operations of mining equipments.

Plants for screening, sizing and Beneficiation of minerals. Principles of re-inforced concrete construction, including design of beams, columns, retaining walls and other structures. Properties of other building materials

(e) MINE SURVEYING

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

EDM: Principles of measurements; types; correction and selection of instrument.
Angular measurement: Prismatic compass; bearing of lines; local attraction; magnetic declination.

Dials: Loose and fast needle surveying; plan table surveying and micro-opticalidade.

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; Gyrothedolite**;** 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.

Use, care, testing and calibration of instruments.

Controlled surveys: 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 system and precise determination of azimuth by astronomical methods.

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

Development: 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, 3Dlaser profiling of bench walls in opencast working.

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 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 and haul road curves, surface and underground.

Sampling and reserve calculations

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

Types of plans, section 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.

ANNEXURE – II

SYLLABUS FOR THE EXAMINATION FOR SECOND CLASS MANAGER'S CERTIFICATE OF COMPETENCY (UNDER METALLIFEROUS MINES REGULATIONS, 1961)

(a) MINE MANAGEMENT, LEGISLATION AND GENERAL SAFETY

MINE MANAGEMENT:

Introduction: Principles of scientific management; management function; planning; organization and control; structure and design of organization for mining enterprises.

Personal Management: Selection, training and development of human resources, conflict; dealing with conflict, motivation and two way personal communications.

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

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

LEGISLATION:

Health and Safety Laws: The Mines Act, 1952; Mines Rules 1955, Meatlliferoyus Mine Regulation, 1961, Mines Rescue Rules, 1985, provisions of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 applicable to mines; Mine Vocational Training Rules, 1966, other rules and legislation as applicable to Metalliferous mines.

GENERAL SAFETY:

Safety in Mines: Causes and prevention of accidents and their classification; frequency rate and severity rates; cause-wise analysis, investigation into accidents and accident report; in-depth study into various causes of accidents, cost of accident; measures for improving safety in mines; Hazard Identification, risk assessment and risk management, Safety Management Plan (SMP), Elements of SMP, Preparation of SMP, Standard Operating Procedure (SOP) and Hazard Management Plans in opencast mines, cost of accident; human elements in mine safety, workers participation in safety management; ISO and safety audit; safety conferences; tripartite and bipartite committees. role of information technology in safety management.

Mine Gases: Generation, Properties and Physiological Effects, Detection of Mine Gases and Multi gas Detectors, Gas Chromotograph, Flame and Electric Safety Lamps.

Mine fires and Hazards , its mitigation.

Inrush of water: Hazards and risk of opencast mining near water bodies, rivers, mitigation measures against risk from inrush of water.

Failure of Benches and Dumps: Strata management. Hazards and risks associated with Bench and Dump stability.

Extreme weather condition: Hazards due to Extreme weather condition in opencast mines and its mitigation

Occupational hazards in surface mining and precautions.

Disaster management: Rescue and recovery; investigations and reports; fire fighting plan; rescue equipments; resuscitation and reviving apparatus; selection and training for rescue work.

First aid and ambulance

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

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

Sanitation and health in mines

Safety related issues in Crushing and ore handling and transport system.

(b) WINNING AND WORKING

Geology: Nature and occurrence of mineral deposit ,their classification; geological features of mineral deposit; methods of boring, boring through disturbed strata; bore hole survey; interpretation of geological maps.

Opening of Mineral deposit: 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.

Developments 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 stoping and factors (depth, thickness, inclination, etc.) affecting the same;methods of development,stone drifting and statutory provisions.

Opencast Mining: Opening of mineral deposit and preparation for excavation; box cut, types; selection of site; Layout of Opencast mine, parameters, formation of production benches; ripping; types of rippers; cycle of operation;

Construction of Haul roads and ramps, width, super elevation / camber, central bund, side bund, slope, base, sub-base, surface, Surface friction, materials required, drainage, curve, visibility, machines to be used, maintenance, monitoring, Haul road crossings, T-junction, tri-junction, four-way crossings, parameters, Parking of HEMM, parking of dump trucks, GO-line design, Shelter construction, view point construction.

Watering of mine roads for dust suppression, methods to be used, hazards due to overwatering, type of water spraying, spot or strip watering.

Drilling; blast hole drills; performance parameters; requirement of number of drills; blasting; use and safe handling of explosives, blasting techniques in stoping and development; blast design; factors influencing blast design; deep hold blasting; calculation of charge per hole; ground vibration; secondary blasting and problems of blasting; environment friendly non-blasting techniques; safety aspects; Permitted explosives.

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; conveyors; shiftable and high angle conveyors; mode of operation etc.; OITDS (operator independent truck dispatch system); in-pit crushing, ore handling plant.

Application of concepts of Rock Mechanics for designing the methods of mining and strata control: Theories of ground movement and strata control; shaft pillar; protection of surface structures; design and stability of structures in rock; design of support and reinforcement for underground excavations and open pits, roof management, consolidated and unconsolidated fills, rock bolts, cable bolts, subsidence; caving of rock mass; bumps; monitoring of rock mass performance; mechanics of rock fragmentation; Dump types, internal and out of pit dumps, Dump construction, size, shape, Site selection and preparation for dumping, Methods of dumping, machines required for dump construction, slope stability; slope angle, benches, berms, factors affecting slope stability, design criteria and monitoring systems; dump stability; dump management.

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

Danger from different sources of water; precautions to prevent inundation, siltation, bench and dump failures; designing drainage system, calculation of catchment area, sump and pump capacity, water dams, retaining walls, siltation ponds, gabion walls, water danger plans.

(c) MINE VENTILATION

Composition of mine atmosphere: Mine gases - generation, properties and effects; sampling and analysis of mine air; and multi-gas detectors; gas chromatograph; monitoring of different gases; telemonitoring.

Flame safety lamps and their design: use of maintenance; testing of safety lamps; lamp house and organization.

Heat and humidity: Sources of heat in mines; geothermal gradient; effects of heat and humidity 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 output control; fans in series and parallel; reversal of air flow; fan drift, diffuser and evasee; booster and auxiliary fans; standards of ventilation; ventilation calculation.

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 development in mine ventilation, ventilation plans.

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

Mine fires: Cause of mine fires, spontaneous combustion, factors affecting spontaneous combustion; detection and prevention; dealing with mine fires; sealing off fire-areas; build-up of extinctive atmosphere; fire fighting organization.

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

Rescue and Recovery: Rescue and recovery in mines - rescue apparatus; organization of rescue work; investigation, emergency preparedness and response system; emergency organization; recovery of mine after fires and inundation.

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

(d) MINING MACHINERY

Strength of materials; Applied mechanics; Fluid mechanics.

Theory of Machines: Machine design, different types of gears and drives, bearing, 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 trial; mechanical efficiency of engines, measurement of indicated and brake horsepower.

Machine tools and workshop 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 fitting; 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, nondestructive testing.

Underground machinery: Jack hammer drills; jumbo drills; roof bolters;; LHDs(Electric or diesel),pnumetic loaders, low profile dump truck (LPDT),service vehicles,man transport vehicles,road headers etc.

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, high angle conveyor, shiftable belt conveyor, pipe conveyor); scraper winches, aerial rope-ways, communication equipment, man riding systems; in-pit crushers, feeder breaker etc., EOT cranes (electric overhead travel) and other cranes, hydraulic lifter, tyre handler, track design and layout; super elevation; track fitting and safety appliances; self acting inclines; rail wagon loading; plants; use of diesel equipments in underground 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(electric and hydraulic): Constructions, function and operation of blast hole drills, rippers, scrapers, shovels; dumpers, Surface Miners, road graders, dozers, wheel loaders; rock breakers and their maintenance aspects, water-trucks, In-pit crushing conveying (IPCC).

Generation, transmission and utilization of Power, Steam and compressed air: Air compressor 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 systems 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; transwitch; symmetrical fault and circuit breaker rating; mine signaling; electrical drives and semiconductor controllers; selection of motors and starters; semiconductor 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.

Generation, transmission and utilization of power, steam, electricity and compressed air in mines; safety aspects.

Automation in mines:- Armchair mining (tele-operations of mining equipments.

(e) MINE SURVEYING

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

EDM: Principles of measurements; types; correction and selection of instrument.

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

Dials: Loose and fast needle surveying; plan table surveying and micro-opticalidade.

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;

Gyrothedolite**;** 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.

Use, care, testing and calibration of instruments.

Controlled surveys: 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 system and precise determination of azimuth by astronomical methods.

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

Development: 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, 3Dlaser profiling of bench walls in opencast working.

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 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 and haul road curves, surface and underground.

Sampling and reserve calculations

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

Types of plans, section 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.

ANNEXURE–III

SYLLABUS FOR EXAMINATION FOR FIRST CLASS MANAGER'S CERTIFICATE

(Restricted to Metalliferous Mines HavingOpencastWorkingOnly)

(Under Metalliferous Mines Regulations, 1961)

(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; organization and control; structure and design of organization for mining enterprises.

Personal Management and Organizational behavior Selection: 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 organization; sources of conflict; dealing with conflict; organizing 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 evaluation; payback period and IRR; methods of cost analysis and cost control; break-even charts; working capital management; ERP (Enterprise Resources 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).RFCTLARR Act, 2013 and laws related to forest land. Technical and biological reclamation and top soil management.

Economic Impact of Mining: Economics of mining effect on community –before, during and after mining.

Materials Management for mining sector.

Behavioural Sciences for Management: Conflict management; conflict in organization; sources of conflict; dealing with conflict; organizing for conflict resolution; conflict and growth; Individual motivation; two way personal communication.

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

LEGISLATION:

Health and Safety Laws: The Mines Act, 1952; Mines Rules 1955, Metalliferous Mine Regulation, 1961, Provisions of, CentralElectricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 applicable to mines; Mine Vocational Training Rules, 1966, other rules and legislation as applicable to opencast Metalliferous mines.

GENERAL SAFETY:-

Safety in Mines: Duty of care, Occupational hazards of mining, causes and prevention of accidents and their classification; accident statistics; frequency rate andseverity rates; cause-wise analysis, basic causes of accident occurrence; investigation into accidents and accident report; in-depth study into various causes of accidents, measures for improving safety in mines; TRAP (take responsibility in accident prevention); cost of accident; SMP (Safety Management Plan); Elements of SMP, Preparation of SMP, Standard Operating Procedure (SOP) and Hazard Management Plans in opencast mines, dealing with accidents and emergencies in opencast mines, Causes of accident or incident, Accident Investigation methods and steps, Accident / Incident reporting, contribution of human elements in mine safety, workers participation in safety management; ISO and safety audit; safety conferences; tripartite and bipartite committees; role of information technology in safety management.

Risk Management: Theory and application, baseline, continuous and issue based risk assessment, how they are applied to technical areas, hazard identification, risk assessment techniques, Work Place Risk Assessment and Control (WRAC), Job Safety Analysis (JSA), Risk Matrix, Risk Management Options, Hierarchy of controls, Control Effectiveness, 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**,** Concept of Triggered Action Response Plan (TARP).

Airbone dust:- Generation, dispersion, measurement and control; suppression and treatment of mine dust; sampling and analysis of air-borne dust, Hazards due to dust in mines..

Mine fires:- Cause of mine fires, dealing with mine fires; firefighting organization; Ore stack and waste dump fires, its mitigation.

Inrush of water: Hazards of opencast mining near water bodies, rivers, mitigation

Failure of Benches and Dumps: Strata management. Hazards and risks associated with Bench and Dump stability.

Extreme weather condition: Occupational hazards in surface mining and precautions

Biological Hazards, Chemical Hazards

Working at heights

Disaster management: Crisis Management Plan (CMP), Rescue and recovery; procedure and responsibilities, safety of persons engaged in emergency response, investigations and reports; assessment of damage, mine rescue.

Emergency Response Plan: Preparation of emergency response plan, Structure of emergency response system, roles and responsibilities, Emergency services, equipments and procedures, emergency control rooms.

First aid and ambulance

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; preventions and treatment.

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

Sanitation and health in mines

Safety related issues in Crushing and Ore handling and transport system.

(b) W|NN|NG AND WORK|NG

Geology: Nature and occurrence of mineral deposits; description of |ndian mineral deposits; application of geology to mining; geological structures; folds, faults, fractures, fissures etc., boring through disturbed strata; bore hole survey; indicated and proved Mineral reserves; interpretation of geological maps.

Opencast Mining: Opening of mineral deposit and preparation for excavation; box cut, types; selection of site; Layout of Opencast mine, parameters, formation of production benches; ripping; types of rippers; cycle of operation; Construction of Haul roads and ramps, width, super elevation / camber, central bund, side bund, slope, base, sub-base, surface, Surface friction, materials required, drainage, curve, visibility, machines to be used, maintenance, monitoring, Haul road crossings, T-junction, tri-junction, four-way crossings, parameters, Parking of HEMM, parking of dump trucks, GO-line design, Shelter construction, view point construction.

Drilling; blast hole drills; performance parameters; requirement of number of drills; blasting; use and safe handling of explosives, blast design; factors influencing blast design; deep hold blasting; calculation of charge per hole; ground vibration; secondary blasting and problems of blasting; environment friendly non-blasting techniques; 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; continuous Surface Miner - operational methods (wide / full base methods, 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;, O|TDS (operator independent truck dispatch system); in-pit crushing, material Handling Plants, Silo and rapid loading system, strip-mining; safety aspects.

Construction of Haul roads and ramps: width, super elevation / camber, central bund, side bund, slope, base, sub-base, surface, Surface friction, materials required, drainage, curve, visibility, machines to be used, maintenance, monitoring, Haul road crossings, T-junction, tri-junction, four-way crossings, parameters, Parking of HEMM, parking of dump trucks, GO-line design, Shelter construction, view point construction.

Watering of mine roads for dust suppression, methods to be used, hazards due to overwatering, type of water spraying, spot or strip watering.

Application of concepts of Rock Mechanics for designing the methods of mining and strata control: Design and stability of structures in rock; design of support and reinforcement for open pits; Types of bench and dump slope failures, Theories of ground movement and strata control; rock bolts, cable bolts; wire mesh; monitoring of rock mass performance, mechanics of rock fragmentation; Dump types, internal and out of pit dumps, Dump construction, size, shape, Site selection and preparation for dumping, Methods of dumping, machines required for dump construction, consolidated and unconsolidated dumps, slope stability; slope angle, benches, berms, factors affecting slope stability, design criteria and monitoring systems; dump stability; dump management.

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

Danger from different sources of water; precautions to prevent inundation, siltation, bench and dump failures; designing drainage system, calculation of catchment area, sump and pump capacity, water dams, retaining walls, siltation ponds, gabion walls, water danger plans,

Application of numerical modeling in mine design, application of computers in mine design and operational controls.

(c) M|N|NG MACH|NERY

Strength of materials; Applied mechanics; Fluid mechanics.

Theory of Machines: Machine design, different types of gears and drives, bearing, 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 trial; mechanical efficiency of engines, measurement of indicated and brake horsepower.

Machine tools and workshop processes

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, high angle conveyor, shiftable belt conveyor, pipe conveyor); scraper winches, aerial rope-ways, communication equipment, in-pit crushers, feeder breaker etc., EOT cranes (electric overhead travel) and other cranes, hydraulic lifter, tyre handler, track design and layout, super elevation; track fitting and safety appliances, self-acting inclines, ore handling plants; rail wagon loading plants.

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 (electric and hydraulic): Constructions, function and operation of blast hole drills, rippers, scrapers, shovels; dumpers, road graders, dozers, wheel loaders;; spreaders; surface miner, rock breakers and their maintenance aspects, water-trucks, ।n-pit crushing conveying (।PCC).

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; transwitch; symmetrical fault and circuit breaker rating; mine signaling; power economics, industrial tariffs; power factor improvement; electrical drives and semiconductor controllers; selection of motors and starters; semiconductor devices; principles of operation of thyristor controlled variable speed electrical drives; electrical breaking; earthing; use of high voltage operational equipment in mines.

Generation, transmission and utilization of power, steam, electricity and compressed air in mines; safety aspects.

Automation in mines:- Armchair mining (tele-operations of mining equipments).

Preventive, periodical and total maintenance systems in mines.

Plants for screening, sizing and Benefication of minerals; Principles of re-inforced concrete construction, including design of beams, columns, retaining walls and other structures; Properties of other building materials.

(d) M।NE SURVEY।NG

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

EDM: Principles of measurements; types; correction and selection of instrument.

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

Dials: loose and fast needle surveying; plan table surveying and micro-opticalidade.

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 of contouring; temporary and permanent adjustment of levels.

Use, care, testing and calibration of instruments.

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

Devlopment: Surveys of flat, moderately and steeply inclined and vertical workings; traversing along steep working with or without auxiliary telescopes; 3D laser profiling of bench walls in opencast working.

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 and universal transfers Mercator; transformation of coordinates.

Astronomy: Astronomical triangle; conversion of time systems and precise determination of azimuth by astronomical methods.

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

Sampling and reserve calculations.

Dip, strike, fault and outcrop problems, borehole surveying and calculations.

Types of plans and sections for opencast workings 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.

ANNEXURE – IV

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

RESTRICTED TO METALLIFEROUS MINES HAVING

OPENCAST WORKING ONLY

(UNDER METALLIFEROUS MINES REGULATIONS, 1961)

(a) MINE MANAGEMENT, LEGISLATION AND GENERAL SAFETY

MINE MANAGEMENT:

Introduction: Principles of scientific management; management function; planning; organization and control; structure of organization for mining enterprises.

Personal Management: Selection, training and development of human resources; conflict; dealing with conflict, motivation and two way personal communications.

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

Environmental Management: Mine Environment monitoring and control; EMP; mine closure plan; R&R (rehabilitation and resettlement).

LEGISLATION:

Health and Safety Laws: The Mines Act, 1952; Mines Rules 1955, Metalliferous Mine Regulation, 1961, Mines Rescue Rules, 1985, provisions of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 applicable to mines; Mine Vocational Training Rules, 1966, other rules and legislation as applicable to Opencast Metalliferous mines.

GENERAL SAFETY:

Safety in Mines: Causes and prevention of accidents; and their classification; frequency rate andseverity rates; cause-wise analysis, investigation into accidents and accident report; in-depth study into various causes of accidents, measures for improving safety in mines; Hazard Identification, risk assessment and risk management, Safety Management Plan, Elements of SMP, Preparation of SMP, Standard Operating Procedure (SOP) and Hazard Management Plans in opencast mines, cost of accident; human elements in mine safety, workers participation in safety management; ISO and safety audit; safety conferences; tripartite and bipartite committees,role of information technology in safety management.

Mine Gases: Generation, Properties and Effects, Detection of Mine Gases, Multi gas Detectors, Gas Chromotograph, Flame and Electric Safety Lamp.

Mine fires and Hazards its mitigation.

Inrush of water: Hazards of opencast mining near water bodies, rivers, mitigation measures against risk from inrush of water.

Failure of Benches and Dumps: Strata management. Hazards and risks associated with Bench and Dump stability.

Extreme weather condition: Occupational hazards in surface mining and precautions

Disaster management: Rescue and recovery; investigations and reports; investigation after surface mine fire; fire fighting plan.

First aid and ambulance

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

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

Sanitation and health in mines

Safety related issues in Crushing and ore handling and transport system.

(b) W।NN।NG AND WORK।NG

Geology: Nature and occurrence of mineral deposit,their classification; geological features of mineral deposit; methods of boring, boring through disturbed strata; bore hole survey; interpretation of geological maps.

Opencast Mining: Opening of mineral deposit and preparation for excavation; box cut, types; selection of site; Layout of Opencast mine, parameters, formation of production benches; ripping; types of rippers; cycle of operation; Construction of Haul roads and ramps, width, super elevation / camber, central bund, side bund, slope, base, sub-base, surface, Surface friction, materials required, drainage, curve, visibility, machines to be used, maintenance, monitoring, Haul road crossings, T-junction, tri-junction, four-way crossings, parameters, Parking of HEMM, parking of dump trucks, GO-line design, Shelter construction, view point construction.

Watering of mine roads for dust suppression, methods to be used, hazards due to overwatering, type of water spraying, spot or strip watering.

Drilling; blast hole drills; performance parameters; requirement of number of drills; blasting; use and safe handling of explosives, blasting techniques in stoping and development; blast design; factors influencing blast design; deep hold blasting; calculation of charge per hole; ground vibration; secondary blasting and problems of blasting; environment friendly non-blasting techniques; safety aspects; Permitted explosives.

Discontinuous / cyclicmethods of excavation and transport: shovel dumper operation; applicability of electric shovel and hydraulic excavators; cycle time and productivity calculation; estimation of equipment fleet;Surface Miners, conveyors; shiftable and high angle conveyors; mode of operation etc. O।TDS (operator independent truck dispatch system); in-pit crushing, Ore Handling Plants.

Application of concepts of Rock Mechanics for designing the methods of mining and strata control: Design and stability of structures in rock; design of support and reinforcement for open pits; Types of bench and dump slope failures, Theories of ground movement and strata control; rock bolts, cable bolts; wire mesh; monitoring of rock mass performance, mechanics of rock fragmentation; Dump types, internal and out of pit dumps, Dump construction, size, shape, Site selection and preparation for dumping, Methods of dumping, machines required for dump construction, consolidated and unconsolidated dumps, slope stability; slope angle, benches, berms, factors affecting slope stability, design criteria and monitoring systems; dump stability; dump management.

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

Danger from different sources of water; precautions to prevent inundation, siltation, bench and dump failures; designing drainage system, calculation of catchment area, sump and pump capacity, water dams, retaining walls, siltation ponds, gabion walls, water danger plans,

(c) M।N।NG MACH।NERY

Strength of materials; Applied mechanics; Fluid mechanics.

Theory of Machines: Machine design, different types of gears and drives, bearing, 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 trial; mechanical efficiency of engines, measurement of indicated and brake horsepower.

Machine tools and workshop processes

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, high angle conveyor, shiftable belt conveyor, pipe conveyor); scraper winches, aerial rope-ways, communication equipment, in-pit crushers, feeder breaker etc., EOT cranes (electric overhead travel) and other cranes, hydraulic lifter, tyre handler, track design and layout, super elevation; track fitting and safety appliances, self-acting inclines, ore handling plants; rail wagon loading plants.

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 (electric and hydraulic): Constructions, function and operation of blast hole drills, rippers, scrapers, shovels; dumpers, road graders, dozers, wheel loaders;; spreaders; surface miner, rock breakers and their maintenance aspects, water-trucks, ।n-pit crushing conveying (।PCC).

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; transwitch; symmetrical fault and circuit breaker rating; mine signaling; power economics, industrial tariffs; power factor improvement; electrical drives and semiconductor controllers; selection of motors and starters; semiconductor devices; principles of operation of thyristor controlled variable speed electrical drives; electrical breaking; earthing; use of high voltage operational equipment in mines.

Generation, transmission and utilization of power, steam, electricity and compressed air in mines; safety aspects.

Automation in mines:- Armchair mining (tele-operations of mining equipments.

Preventive, periodical and total maintenance systems in mines.

(d) MINE SURVEYING

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

EDM: Principles of measurements; types; correction and selection of instrument.

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

Dials: loose and fast needle surveying; plan table surveying and micro-opticalidade.

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 of contouring; temporary and permanent adjustment of levels.

Use, care, testing and calibration of instruments.

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

Development: Surveys of flat, moderately and steeply inclined and vertical workings; traversing along steep working with or without auxiliary telescopes; 3D laser profiling of bench walls in opencast working.

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 and universal transfers Mercator; transformation of coordinates.

Astronomy: Astronomical triangle; conversion of time systems and precise determination of azimuth by astronomical methods.

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

Sampling and reserve calculations.

Dip, strike, fault and outcrop problems, borehole surveying and calculations

Types of plans and sections for opencast workings 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.

[F. No. DGMS/ EXAMS/MMR/ BYE LAWS/ 2021/1]

PRABHAT KUMAR, Chief Inspector of Mines & Chairman, Board of Mining Examination