CBCS SCHEME

USN | 2 | N | D | 2 | 4 | C | N | 4 | 0 | 3 | BCV405B

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Construction Equipment, Plants and Machinery

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Draw and explain four and two stroke engine.	10	L2	CO1
	b.	Explain components of automobiles with neat diagram.	10	L2	CO1
		OR			
Q.2	a.	Explain basic layout of hydraulic system with neat sketch.	10	L2	CO1
	b.	Explain Strand Jack Operation and write the application of Hydraulics.	10	L2	CO1
		Module – 2			
Q.3	a.	Explain concreting and road making.	10	L2	CO2
	b.	Draw line diagram of bulldozer and write its components.	10	L2	CO2
		OR			
Q.4	a.	Explain Excavator with line diagram.	10	L2	CO2
	b.	Explain Motor Grader and classification of Motor grader.	10	L2	CO2
		Module – 3			
Q.5	a.	Explain equipment life cycle management.	10	L2	CO3
	b.	Explain equipment performance parameter.	10	L2	CO3
		OR			
Q.6	a.	Explain types of Maintenance.	10	L2	CO3
	b.	Explain Maintenance Practices.	10	L2	CO3
		Module – 4			
Q.7	a.	Explain the operation of hard rock.	10	L2	CO4
	b.	Explain earth pressure balance.	10	L2	CO4
		OR			
Q.8	a.	Explain operation of slurry by TBM.	10	L2	CO4
	b.	Explain Hydraulic grabs and piling Rig.	10	L2	CO4
		Module – 5			
Q.9	a.	Explain importance of digital analytic.	10	L2	CO5
	b.	Explain railway track construction.	10	L2	CO5
		OR			
Q.10	a.	Explain 3D concrete printer in construction field.	10	L2	CO5
	b.	Explain safety of men and machines at work.	10	L2	CO5

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Construction Equipment, plants and Machinery (BCV405B) – June/July 2025 Solved VTU Question Paper 4th sem

Module 1

Q1.a) Draw and Explain four and two stroke Engine. (10M)

Sol: A) Four Stroke Engine –

I) Defination – An Engine in which one power cycle is completed in four piston strokes (two crank shaft) Revolutions

II) working Principle –
1) Suction Stroke – Inlet valve open, piston moves down, air/fuel enters
2) Compression stroke – Both valves closed, piston moves up, mixture compressed
3) Power Stroke – Spark ignition, gases expand, piston moves down
4) Exhaust Stroke – Exhaust valve open, piston moves up, gases expelled.

III) Merits – High Efficiency, less fuel consumption Longer life

IV) Demerits – Heavy and Complex, More Maintenance

B) Two Stroke Engine –

I) Defination – Completes one power cycle in two Strokes (one Crankshaft) revolution

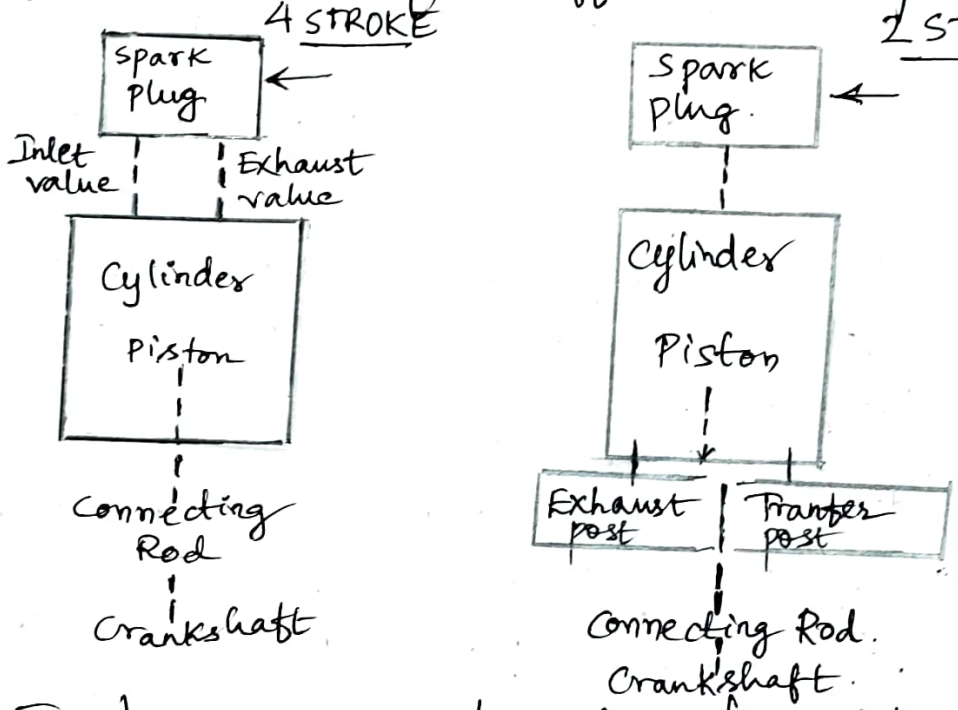
II) Working Principle –
1) Upward Stroke – Compression and Suction

simultaneously

2) Downward stroke – Power and exhaust simultaneously

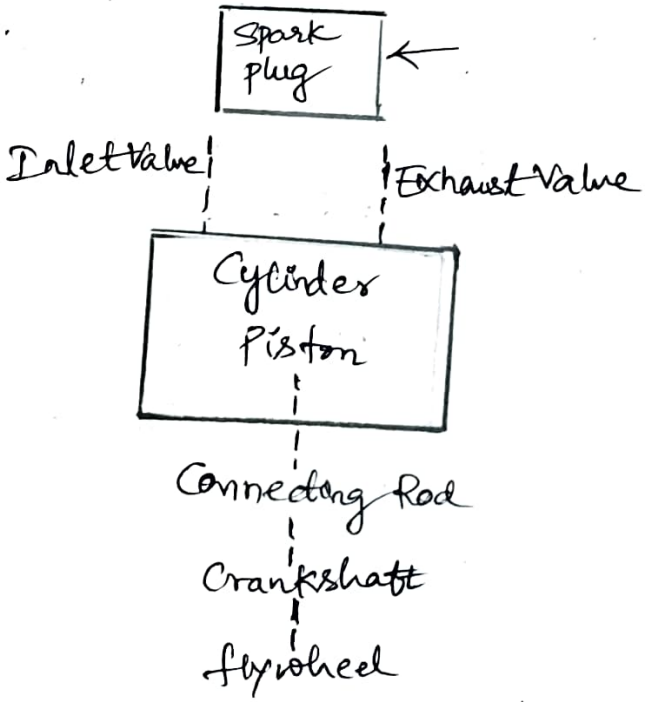
III) Merits – Simple design, light weight, High Power to weight ratio.

IV) Demerits – less fuel Efficient, More pollution.



Q1 b) Explain Components of automobiles with neat diagram. (10M)

Sol.



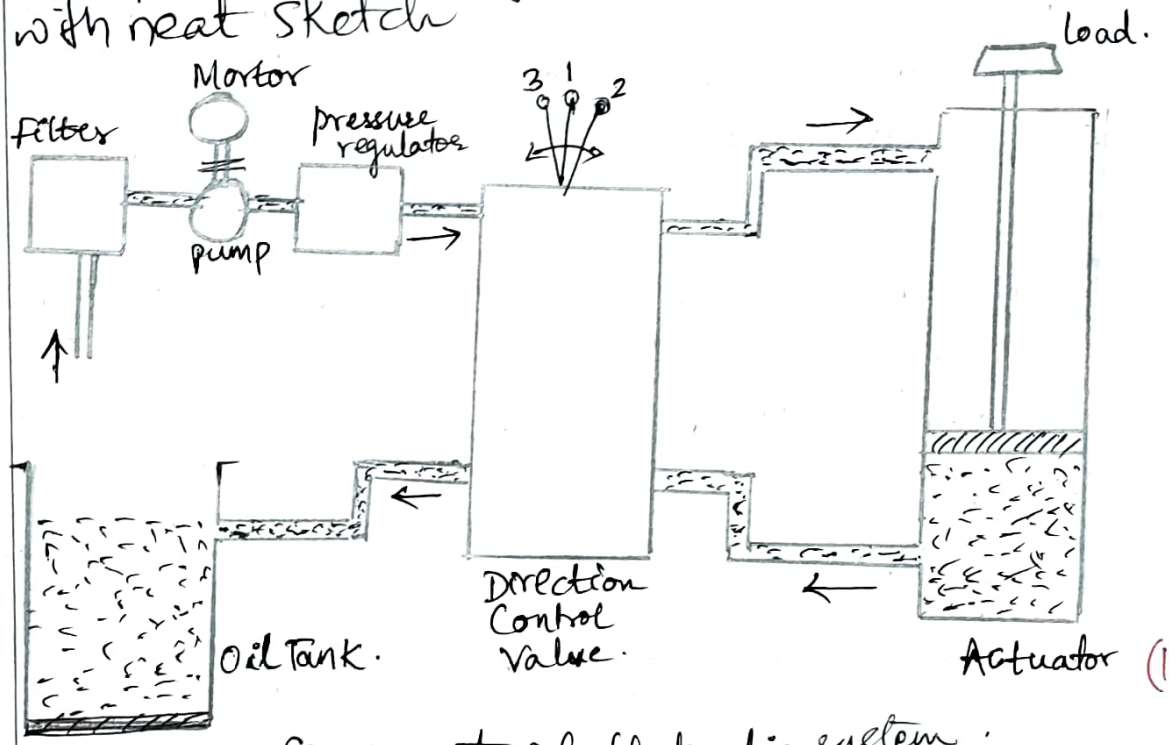
Fuel Injector/Carberetor → side connection

oil. sump (Crank case) → Bottom chamber.

1. Engine (Power Source) – the engine is the heart of automobile. It converts chemical energy of fuel into Mechanical energy. It generates power required to move the vehicle
2. Transmission System – It transfers power from the engine to the wheels
   a) clutch – Allows smooth starting and gear shifting
   b) Gearbox – Controls speed and Pulling Power
   c) Propeller shaft – Transfers power to driving wheels
3. Steering System – It controls the direction of the vehicle. It helps driver control and changes direction safely.
4. Braking System – It is used to slow down or stop the vehicle. Ensures safety by controlling speed and stopping vehicle.
5. Suspension systems – It absorbs shocks from road surface. It provides smooth ride and maintains tyre contact with road.
6. Chassis – It is the main supporting frame of the vehicle. It acts as backbone of automobile
7. Electrical Systems – Provides Electrical Power for starting and lighting. It supplies power for ignition, lighting, horn and accessories

OR

Q2 a) Explain basic layout of hydraulic system with neat sketch



(10M)

Components of Hydraulic system.

⇒ Main Components:
1) Reservoir (Tank) – stores Hydraulic oil
2) Pump – Converts Mechanical energy to Hydraulic energy.
3) Control Valves – Direction Control, Pressure Control
4) Actuator – Hydraulic cylinder or Motor
5) Filters – Removes impurities
6) Pipes & Hoses

⇒ Working Principle: Pump draws oil → pressurized → valve Control flow → actuator moves → oil returns to tank.

⇒ Advantages:
High Power transmission
Smooth Operation
Compact System

(Q2 b) Explain strand Jack operation and write the application of Hydraulics. (10M)

Sol. Strand Jack is a Hydraulic lifting device used to lift or lower very heavy loads (like bridge girders, large beams, heavy structures) using high strength steel strands. It works on the Principle of Hydraulic Pressure (Pascal's law)

⇒ Main Components:- Hydraulic cylinder, Upper wedge, lower wedge, steel strands, Hydraulic Pump

⇒ Working Operation:- The lifting process happens as follows

1) Gripping stage - the upper wedge grips the steel strands tightly. Hydraulic pressure is applied

2) Lifting stroke - The Hydraulic cylinder extends upwards since the strand is gripped, the load moves upward.

3) Locking stroke - The lower wedge now grips the strand. Upper wedge releases.

4) Reset stroke - Cylinder retracts to original position. Process repeats until required height is reached.

This repeated gripping and lifting action allows controlled and safe lifting of very heavy loads

⇒ Applications :-

Bridge Grider erection, Launching of bridge segments lifting Heavy steel structures, Prestressed Concrete Works and offshore platform lifting.

Module 2

Q3a) Explain concreting and road making. (10M)

Sol I. Concreting –

⇒ Definition: Is the process of Mixing, placing, compacting, finishing and curing concrete to obtain a strong and durable structures.

⇒ Steps in Concreting –

1. Batching – Can be done by weight or volume. Ensure proper strength and quality.
2. Mixing – Done manually or using concrete Mixer, ensure uniform distribution of cement paste
3. Transportation – Transporting fresh concrete to site, by wheel barrow, transit Mixer, conveyor, pump are the different methods. It should be quick to avoid setting
4. Placing – It should be placed in layers. Pouring Concrete into formwork. Avoid segregation and free fall from height
5. Compaction – Removing air voids using Vibrators by needle vibrator, surface vibrator. It increase strength and durability
6. Finishing – Leveling and smoothing surface done using trowels and floats.
7. Curing – Keeping Concrete moist for 7 to 28 days methods are Water Curing and membrane curing To Prevent Cracks and Increase strength

⇒ Equipment used are – Concrete Mixer, Vibrator, Concrete pump, Transit Mixer and Batching plant.

II Road Making –

⇒ Definition: Road making is the Process of constructing a stable and durable road surface for safe transportation.

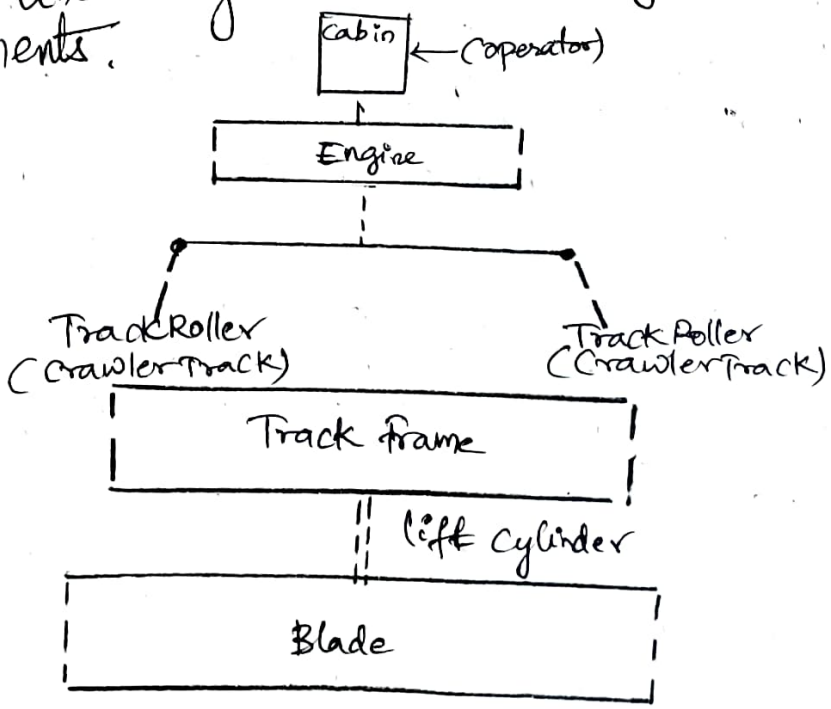
⇒ Steps in Road Construction

1. Survey and alignment – selection of route, marking center line
2. Earthwork (Subgrade preparation) – clearing vegetation, excavation and filling, compaction of soil. Subgrade is foundation of road.
3. Sub base Course – layer of gravel or crushed stone, provide drainage and load distribution.
4. Base Course – Strong layer above sub-base, made of WBM (Water Bound Macadam) or bituminous base
5. Wearing Course (Surface Course) – Top layer (Bitumen or concrete), Provides smooth riding surface
6. Compaction – Done using road rollers; ensures strength and durability.

⇒ Equipment used – Bulldozer, Excavator, Motor grader, Road roller, Paver finisher, Bitumen sprayer.

(Q3b) Draw line diagram of Bulldozer and write its Components. (10M)

Sol.



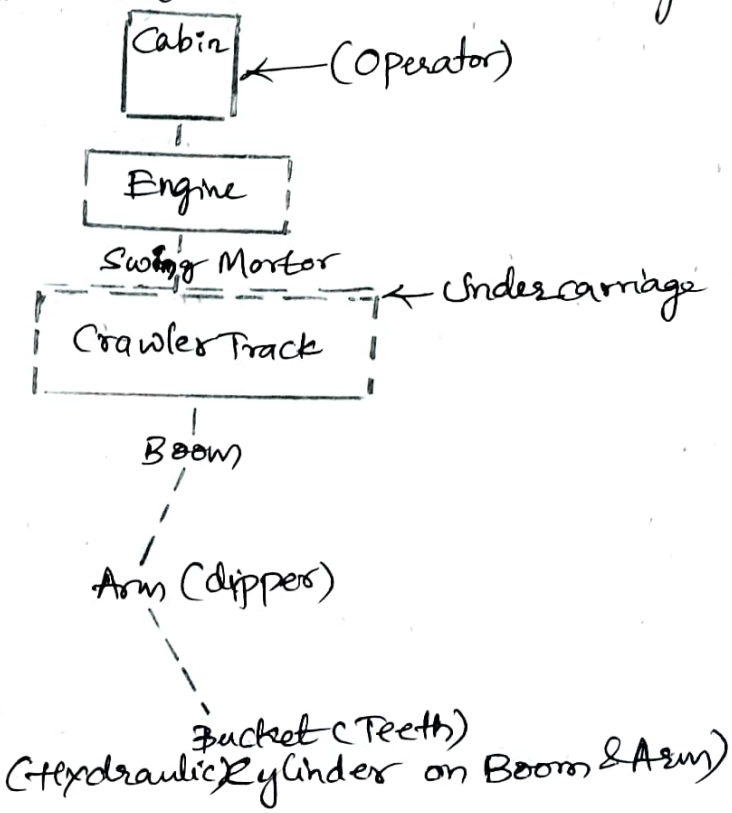
A bulldozer is a powerful tracked tractor fitted with a ~~blaze~~ blade used for pushing, leveling and earth moving Operations

1. Engine - Used as a heart of the bulldozer. Provides power to move the Machine and operate Hydraulic. Usually a high Power diesel Engine.
2. Blade - large metal plate fixed at the front used for pushing soil, sand debris and rocks Type of Blade include Straight Blade (S Blade) Universal Blade (U Blade) Semi U Blade
3. Track (Crawler Track) - gives better grip and satibility Continuous metal chain plates instead of wheels Helps in working on Muddy and uneven surfaces
4. Hydraulic System - Includes Hydraulic pump, Cylinder and Control Values, used to raise, lower and tilt the blade. Allows smooth and powerful Control of blade movement
5. Transmission System - It transfer power from engine to Tracks, it includes gear box, torque Convertor and final drive & Control Speed and movement direction
6. Ripper - It locates at rear of bulldozer, Used to break hard soil or rock before pushing
7. Operator Cabin - It enclosed Space for driver, Contains Control levers, pedals and steering Controls, Modern dozers have AC, Safety glass and ROPS
8. Frame/Chassis - Heavy steel structure Supporting all components, designed to withstand heavy loads and impact.

OR.

Q4 a) Explain excavator with line diagram (10M) ⑨.

Sol.



⇒ Main Components of excavator

1. Boom :- long upper arm attached to the machine body, provides height and reach
2. Arm :- Connected to the boom, Holds and Contd the bucket
3. Bucket :- Used for digging soil or loading materials, different types are for general purpose rock bucket, trenching bucket
4. Cabin (Operator Cabin) :- place where operator sits, contains control levers and pedals.
5. Hydraulic Cylinder :- Control movement of boom, arm and bucket, Operate on hydraulic pressure
6. Undercarriage (Tracks) :- Crawler tracks provide stability, Suitable for rough and soft ground
7. Engine : Provides power to hydraulic system

⇒ Working Principle -

* Engine drives Hydraulic pump
* Hydraulic oil under pressure moves cylinder
* Boom, arm and bucket moves as per operator control
* Bucket digs soil and loads it into trucks.

⇒ Applications.
* Digging foundation
* Demolition work
* Trenching for pipelines
* Loading Materials
* Road construction.

Q4b) Explain motor Grader and classification of Motor Grader. (10M)

Sol: Defination - Is a construction machine used mainly for leveling, spreading and finishing surfaces in road construction and maintenance works

⇒ Main Components of Motor Grader -
* Moldboard (Blade) - long curved blade located between front and rear wheels, can rotate, tilt and angle
* Engine - Provides power for movement and Hydraulic system, works on diesel engine
* Hydraulic System - Controls blade movement and helps in lifting, tilting and rotating mold board.
* Frame - long frame connecting front and rear axle and may be grid or articulated
* Wheels - It has 6 wheels, rear wheels provide

driving power

* Operator Cabin - Controls steering, blade movement and machine operation

* Scarifier / Ripper - Used to loosen hard soil before grading.

⇒ Classification - Classified based on different types

* Based on frame grader Type -

1) Rigid frame grader - Frame is fixed, less flexible, suitable for light work

2) Articulated Fram Grader - Frame bends in Middle, Better maneuverability, Used for heavy and Modern road Works

* Based on Drive System -

1) Two wheel drive (2WD) - Rear wheels are driven, Used for normal grading work;

2) All wheel Drive (AWD) - Both front and rear wheels are powered; Used in diffault terrain and heavy work.

* Based on Size -

1) legut grader 2) Medium Grader 3) Heavy Grader

Module 3

(Q5 a) Explain Equipment life cycle Management? (10M)

Sol. Definition - Equipment lifecycle management is the systematic process of managing construction equipment from its planning and purchase to operation, maintenance and final disposal to ensure maximum efficiency and minimum cost

It helps in improving productivity and reducing downtime

⇒ Stages of Equipment life cycle consists of following

* Planning stage - Identify equipment requirement based on project, analyze capacity, type and number of Machine needed, cost analysis and feasibility study is done, objective is to select the right equipment for the right job.

* Procurement Stage - Purchasing or renting equipment vendor selection, inspection and commissioning and objective to acquire equipment economically and efficiently.

* Operation stage - Equipment is put into use, proper training of operators, monitoring fuel consumption and productivity and objective is to achieve maximum output

* Maintenance Stage - regular servicing and lubrication, preventive and predictive maintenance repair and replacement of worn out parts. Objective is to reduce breakdown and increase service life

* Replacement / Disposal stage - Evaluate performance and repair cost, decide whether to overhaul or replace, scrap or sell equipment. The objective to avoid high maintenance cost and inefficiency.

⇒ Importance :- Reduces Operating cost; minimizes

breakdown time; increase equipment reliability; improves project efficiency; enhances safety and maximizes return on investment

(Q5 b) Explain equipment performance parameters. (10M)

Sol. Definition - Equipment performance parameters are the measure used to evaluate the efficiency productivity, reliability and cost effectiveness of construction equipment. It helps in deciding whether the equipment is performing properly or not.

⇒ Major equipment performance parameters -

* Availability - availability indicates the percentage of time the equipment is ready for use; higher availability means fewer breakdowns.
* Utilization - It shows how effectively the available equipment is being used; low utilization means idle machine time.
* Productivity - Productivity is the amount of work done per unit time; higher productivity means better performance.
* Fuel Efficiency - Indicates fuel consumption per unit of output; lower fuel consumption for same work means better efficiency
* Downtime - Downtime is the time during which equipment is not working due to breakdown or maintenance. Less downtime improves productivity.

* Operating Cost - includes fuel cost, maintenance cost, Operator salary, depreciation; lower operating cost increases profit.

* Reliability - Ability of equipment to perform without failure for a given period; high reliability reduces maintenance cost.

⇒ Importance - Helps in cost control; improves planning; reduces breakdowns; increases equipment life; improves project efficiency.

OR.

Q5 a) Explain types of maintenance. (10 M)

Sol: Maintenance is the process of inspecting; Servicing repairing and replacing parts of equipment to ensure proper working condition and increase service life.

⇒ Main types of maintenance -

1) Preventive maintenance - is carried out before breakdown occurs; done at regular intervals; includes lubrication, inspection, cleaning, adjustments and objective to prevent failure and reduce downtime. Eg: regular greasing of moving parts

2) Corrective Maintenance - is done to correct faults detected during inspection; Repairs small defects before they become major problems; The objective is to restore equipment to proper condition. Replacing worn-out belt after inspection.

3) Breakdown Maintenance. - performed after

equipment fails. Also called reactive maintenance. Machine is repaired only after failure It causes production loss is one of the disadvantage

4) Predictive Maintenance - It is based on condition monitoring; Uses viberation analysis; oil analysis, temperature monitoring; maintenance is done only when necessary. The objective is to avoid unnecessary servicing. Eg replacing bearing after vibration analysis shows abnormal value.

5) Scheduled Maintenance - Maintenance carried out at predetermined time intervals, weekly monthly or yearly basis; recommended by manufacturer, to ensure systematic servicing.

⇒ Importance of Maintenance - Reduce downtime, increase equipment life, improves safety, reduces repair cost and increase productivity.

Q6 b) Explain maintenance Practices. (10M)

Sol. Defination:- maintenance practices are the systematic procedures followed to keep equipment in good working condition, reduce breakdown and increase service life. Proper maintenance practices improve productivity and safety in construction projects

⇒ Importance of Maintenance Practices

1) Regular inspection - Daily and periodic checking of equipment; check oil levels, fuel levels, tyre

pressure, hydraulic leak; identify minor defects early; to prevents major breakdowns.

2) Proper lubrication - Regular greasing of moving parts; Use correct grade of oil as recommended; maintain proper lubrication ~~Sed~~ Schedule; to reduce friction and wear

3) Scheduled Servicing - Follow manufacturer's services manual; replace filters, engine oil, coolent at fixed intervals; to increase the equipment life.

4) Record Keeping - Maintain log book of operation hours; Record fuel consumption; repair history and downtime; hence it help in performance analysis and replacement decisions.

5) Spare Parts Management - Keep essential spare parts in stock; Use genuine parts only; Avoid delay in repairs; to reduce downtime

6) Skilled Operators - Proper training of operator; avoid overloading and misuse; follow safety guidelines; so that it improves efficiency and reduce damage.

7) cleanliness and storage - Keep equipment clean; protect from dust, rain and corrosion store properly when not in use; So that it prevent from rust and deterioration

8) Condition Monitoring + Monitor vibration, temperature and noise; detect abnormal behaviour early and so that it supports predictive maintenance.

Module 4

(10M)

Q7a) Explain the Operation of Hard Rock

Sol. Defination - Hard rock TBM (Tunnel boring machine) is a tunneling machine used for excavation in hard rock formations like granite, basalt and limestone; It breaks rock mechanically using disc cutters mounted on a rotating cutter head.

⇒ Main Components - Cutter head, Disc cutter, thrust system (Hydraulic jack), Main bearing, muck removal system, Segment erector, backup system

⇒ Working / Operation of Hard Rock TBM

1) Rotation of Cutter head — the cutter head rotates continuously, disc cutters press against to rock surface.

2) Rock Breaking — High pressure is applied by hydraulic jacks, disc cutters create cracks in rock, rock breaks into small fragments due to compression and shear forces Hence rock is not cut like soil - it is crushed and fractured.

3) Muck Removal - Broken rock pieces (muck) fall through openings in cutter head. Muck is transported using conveyor belt or muck cars; removed to surface.

4) Forward Movement - Hydraulic jacks push the TBM forward, thrust is taken from previously installed tunnel lining.

5) Tunnel Lining - Precast concrete segments are installed behind cutterhead; segment erector places segments in circular form; this forms permanent tunnel lining

6) Continuous Advancement - Cutting → Muck removal → lining → forward push; process repeats until tunnel completion.

⇒ Advantages - Smooth tunnel surface; high accuracy; less overbreak; safer than drilling and blasting; suitable for long tunnels.

⇒ Applications - Railway tunnels; metro tunnels; Hydropower tunnels; highway tunnels; mountain tunnels.

(Q7b) Explain earth Pressure balance. (10M)

Sol. Defination - Earth pressure balance (EPB) is a type of TBM used for tunneling in soft soil and ground (loose ground) condition. It maintain the earth pressure at the tunnel face by balancing it with excavated soil inside the machine chamber
Main purpose - To prevent tunnel face collapse and ground settlement

⇒ Main Components of EPB TBM.
Cutter head, excavation chamber, Screw Conveyor, Hydraulic thrust system, Segment erector, Backup system

⇒ Working / Operation of EPB TBM
Excavation - the cutter head rotates and cut soil; excavated soil enters the Pressure

Chamber behind the cutterhead.

2) Pressure balancing - the excavated soil is kept inside the chamber; soil creates counter pressure; the pressure inside the chamber balances the earth and water pressure at tunnel face this prevent collapse of soil.

3) Controlled soil removal - A screw conveyor removes soil gradually; speed of screw conveyor controls the pressure; if soil is removed fast pressure drops and if soil is removed slowly pressure increases.

4) Forward Movement - Hydraulic jack push the TBM forward. thrust is taken from previously installed lining segments

5) Tunnel lining - Precast concrete segments are installed behind the cutterhead; segment erector placed them in circular shape; Permanent tunnel lining is formed

6) Continuous Process → Cutting → Pressure balancing → soil removal → lining → Forward push → this process repeats Continues until tunnel completion.

⇒ Advantages - Suitable for soft clay and sandy soil; Controls ground settlement; Safe for urban areas; no need for slurry system reduced vibration.

⇒ Application - Metro rail tunnel, Urban underground tunnel, Sewer tunnel, tunnel in soft ground.

OR.

(Q8 a) Explain operation of slurry by TBM (10M)

Sol. Defination – slurry TBM is a type of tunnel boring machine used for tunneling in soft soil, loose ground and water bearing strata It uses pressurized slurry (bentonite mixture) to support the tunnel face and prevent collapse

⇒ Main Components of slurry TBM

Cutter head, slurry chamber, ~~slump~~ slurry pump, slurry separation plant, screw / slurry pipeline system, Hydraulic system, segment erector.

⇒ Working Operation of slurry TBM

* Cutting the soil – The cutter head rotates and excavates soil at the tunnel face and excavated material enters the slurry chamber

* Face Support Using slurry – Bentonite slurry is pumped into the chamber, the slurry creates Hydrostatic pressure, this pressure balances the earth pressure and water pressure this prevents collapse of tunnel face.

* Mixing and Transport – excavated soil mixes with slurry. This mixture (slurry + soil) is pumped through pipelines to the surface.

* Slurry Separation – At surface the slurry

mixture goes to a seperation plant, soil particles are Separated, clean slurry is reused and sent back to TBM

* lining Installation - After excavation of a segment length, precast concrete segments are installed inside the tunnel and this forms permanent tunnel lining

* Advancement - Hydraulic jack push the TBM forward, process repeats Continuosly

⇒ Advantages - Suitable for water bearing soil, provides excellent face stability, Reduce ground Settlement, Safe for urban tunneling

* Application - Metro rail tunnel, Underwater tunnel, Tunnel in soft clay or sandy soil, Urban Undergroind construction

Q8 b) Explain Hydraulic grabs and piling Rig (TOM)

Sol. I) Hydraulic grab - is an excavation tool used for deep excavation, trenching, diaphragm wall Construction and foundation work. It operates using a Hydraulic system to open and close the jaws (clamshell bucket).

⇒ Main components - Grab, bucket (two jaws), Hydraulic cylinder, Wire rope or guide system Crane or Rig support

⇒ Working of Hydraulic Grab -

The grab is lowered into soil using a crane orig; Hydraulic pressure close the jaws; Soil is trapped between the jaws; The grab is lifted to the surface; Jaws are opened to release soil. This process is repeat until required depth is achieved.

⇒ Application of Hydraulic Grab
* Deep foundation excavation;
* Diaphragm wall construction
* Canal and wall digging
* Excavation in soft soil
* Underground structure construction.

II Piling Rig — is a heavy construction machine used to install piles into the ground to provide foundation supports for building and bridges.

⇒ Main components — Mast (Vertical support structure); Hydraulic Hammer or rotary drive Winch system; Power unit (engine); Operator Cabin.

⇒ Working of Piling Rig - Different methods
* Impact Hammer method - pile is positioned vertically, Hammer repeatedly strikes the pile; piles are driven into the soil by impact force.

* Hydraulic Pressure Method – Hydraulic Pressure pushes pile into ground, Used in Urban area (less Vibration)
* Rotary Bored method – Drill rotates and remove Soil, concrete is poured into bored hole, reinforcement Cage is placed.

⇒ Application of Piling Rig – High rise buildings, Bridge foundation, Marine structure, industrial structures, weak soil areas.

Module 5

(Q9a) Explain Importance of Digital analytic (10M)

Sol. Digital analytic refers to use of digital tools, software, sensors and data analysis techniques to collect, monitor and analyze performance data for better decision making. In construction and equipment management, digital analytics helps to improve efficiency, productivity, safety and cost control.

⇒ Importance of Digital Analytics.

1) Performance Monitoring – Tracks equipment equipment productivity in real time; Monitors fuel consumption, idle time and output. Hence it helps to identify underperforming machines.

2) Predictive maintenance – Uses sensor data to detect early faults; Prevents sudden breakdowns; Reduces downtime and repair costs

3) Cost Control – It tracks operating cost, fuel usage and maintenance expenses; Helps control project budget; it improves profitability

4) Better decision Making – Provides accurate data instead of assumptions. Helps in equipment selection and replacement decisions. It reduce risk of wrong investment

5) Productivity Improvement – Identifies bottlenecks in the workflow; Optimizes equipment utilization and increases overall project efficiency.

6) Safety Enhancement – Monitors equipment health; tracks unsafe operating conditions Helps reduce accidents; improves site safety

7) Resource Optimization – Optimizes manpower and machinery usage; Reduce idle time; Maximizes return on investment.

8) Real Time Reporting – Provides dashboards and performance reports, enables quick corrective action

⇒ Application – Fleet management system; GPS tracking; equipment health monitoring; project management software; BIM based data Analysis.

Q9b) Explain railway track construction (10M)

Sol. Railway track construction is the process of laying railway lines to provide a stable, durable and safe path for train movement

* It mainly consists of Rails, Sleepers, Ballast, Sub-grade. and Components of Railway Track are Rail, Sleepers, Ballast, Subgrade.

→ Rail - steel sections that guide train wheels

→ Sleepers (Ties) - Support rails and maintain gauge

→ Ballast - Crushed stones placed below sleepers for load distribution

→ Subgrade - Compacted soil foundation below ballast.

* Steps in railway Track Construction -

1) Survey and alignment - selection of route; Marking centerline and gradients; soil investigation is carried out; It helps to ensure safe and economical alignment.

2) Earthwork and Formation - clearing vegetation; excavation and filling; compaction of subgrade soil; Hence it provide stable foundation

3) laying of Ballast - layers of crushed stones is spread over subgrade; thickness is maintained as per design and provides drainage and load distribution

4) Sleeper placement – sleepers are placed at equal spacing; Materials are concrete, steel or wooden sleepers; Maintain correct gauge.

5) Rail laying – Rails are placed on sleepers; fastened using clips, bolts and fish plates; gauge is checked carefully.

6) Packing and Tamping – Ballast is packed around sleepers; tamping machine compacts ballast; ensures proper stability and alignment

7) Alignment and leveling – Track geometry is checked and final adjustment are made.

⇒ Types of railway Tracks – Broad gauge, Meter gauge and Narrow gauge.

OR.

Q10 a) Explain 3D concrete printer in construction field. (10M)

Sol. Defination: 3D Concrete Printer is an advanced construction Technology that builds structures by printing concrete layer by layer using automated robotic system, based on a digital design Model. The following the principle of additive manufacturing

⇒ Main components of 3D Concrete Printer

1) Robotic Arm / Gantry System
2) Concrete Extrusion Nozzle

3) Special Concrete Mix
4) Computer Control System
5) Pumping System.

⇒ Working Principle :- It involves Digital Design
1) Material Preparation
2) layer by layer Printing
3) Setting and Hardening
4) Application in Construction

⇒ 1) Residential houses
2) low cost housing Project
3) Emergency shelters
4) Boundary Walls
5) Architectural elements
6) Small Bridges.

⇒ Advantages
1) Faster Construction
2) Reduced labour Cost
3) Cost effective
4) No formwork needed
5) Less Material Wastage
6) Environmental friendly

(Q10b) Explain Safety ~~and~~ of Man and Machines at Work (10M)

Sol. Defination – Safety of Man and machines refers to the measures taken to prevent accidents, injuries, damage to equipments at construction sites or workplace It ensure protection of Workers as well as

proper functioning of Machinery.

⇒ Importance of safety :

1) Prevent accidents and injuries
2) reduces equipment damage
3) Avoid project delays
4) Improves productivity
4) Ensure legal compliance.

⇒ Safety of Men (Workers)

1) Use of Personal Protective equipment (PPE)
2) Proper Training
3) Safe Working Practices
4) Proper Supervision
5) Good House Keeping

Safety of Machines

1) Regular inspection
2) Preventive maintenance
3) Machine Guards
4) Safe Operating limits
5) Proper parking and storage.

Staff in charge

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