CURRICULUM GUIDE
[SHORT COURSE]

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Repairing and Maintenance of Pump Set [Diesel Engine and Water Pump]

Council for Technical Education and Vocational Training
CURRICULUM DEVELOPMENT DIVISION
Sanothimi, Bhaktapur
2002

Aim and Objectives:

The aim of this course is to produce repairing and maintenance technician of diesel engine and pump set use in irrigation. The objectives include;

- To upgrade farmers indigenous skill.
- To produce skilled technician in the field of pump set repairing and maintenance in local level partially, and
- To create employment opportunity

Course Description:

This course deals with theory and practical aspects of repairing and maintenance of pump set. This course includes humbling of tools, routine maintenance, over haul, recondition, assembling, and dissembling with proper identification of parts and their location.

Target Group :

- Farmers / pump set users cum operators
- Other keen interested persons

***Group Size*:** 10 nos. in one group

Duration: 280 hours

Pattern Of attendance:

90% attendance should secure during the training period.

Entry Criteria :

- Literate
- Physically sound

Certificate requirement :

Institute itself provides certificate to those trainees who successfully complete the prescribed course and conducted evaluation.

Trainers' qualification :

1. Min. diploma in automechanics

Trainees Evaluation:

Continuous evaluation system will be followed for each task performance and summative test will be conducted after the completion of whole course.

Tasks list

S.N.	Tasks	Time distributions		
		Th	Pr.	Total
1	Handle / operate mechanical tools and equipment	1	4	5
2	Maintain / apply general safety rule	2	2	4
3	Perform pre-start check up	1	3	4
4	Operate pump set	1	3	4
5	Service air cleaner	1	4	5
6	Service silencer	1	3	4
7	Change engine oil	1	3	4
8	Change fuel filter	1	4	5
9	Change oil filter	1	3	4
10	Dismantle diesel engine	4	24	28
11	Service rocker boll assembly	1	6	7
12	Service cylinder head	2	12	14
13	Service cylinder block	2	10	12
14	Service piston and connection rod	2	10	12
15	Recondition can shaft	2	12	14
16	Recondition crankshaft and main bearings	2	20	22
17	Service lub oil pump	3	10	13
18	Service crank case	1	3	4
19	Service fuel injection pump	3	15	18
20	Service injector	2	6	8
21	Assemble diesel engine	2	24	26
22	Adjust tappet clearance	2	8	10
23	Set idle speed of engine	1	3	4
24	Perform routine maintenance [diesel engine]	2	3	5
25	Maintain log book	1	3	4
26	Perform pre-operate check up	1	3	4
27	Allain pump with enigne	1	3	4
28	Pack gladdening on pump	1	3	4
29	Overhaul centrifugal pump	2	10	12
30	Service impeller	1	4	5
31	Assemble centrifugal pump	1	6	7
Total		49	227	276

Facilities:

Descriptions	**Numbers:**
1. Class room for 30 students	1
2. A / V room	1
3. Slide presenter	1
4. Computer with CD ROM attachment	2
5. Motor Blow Spraying Equipment	5
6. Back Pack Sprayer with all nozzles types used in Tea	10
7. Pruning Knives 6,8,10,12 inches blade size	12 each size
8. First aid kit	1
9. Cheel hoe	5
10. Spade	30
11. Sickle	30
12. Planting Hoe	30
13. Planting Chain	5
14. Bamboo Sticks 1.5 Feet Size	5 poles
15. Polythene sleeves	5 kg.
16. Sand,Silt ,Clay Types of Soil	3 cu.ft per items
17. Shaving Blades for cuttings	30
18. Protective clothing for Spraying Person, masks goggles, gloves	30
19. Auger for soil sample drawing	5
20. Khurpi	30
21. Land (can be rented)	2 hectors (min.)
Vehicle (can be rented) 1	

Task Analysis

Time: 5 hrs
Theory: 1 hrs
Task No:**1** Handle / operate mechanical tools & equipment Practical: 4 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1.	Identify mechanic hand tools.	**Condition (Given):**	➢ Definition, types, purpose and uses of hand tools..
2.	Enlist the function and uses of hand tools.		
3.	Discuss the application of different types of tools.	In a workshop with mechanics hand tools and equipment.	➢ Tools safety rules.
4.	Interpret tools handling rule and their handling technique.		
5.	Select the proper tools for the job.	**Task (What):**	
6.	Handle the right tool for the job safely.		
7	Maintain the tools clean and proper.	Handle / operate mechanical tools & equipment	
		Standard (How well): • Select right tool for right job. • Handle tools safely & properly. • Clean the tools after use. • State the tools in proper place.	

Required tools/equipment: Open and ring spanner set, socket wrench set, screw drivers (flats & Philips), Hammers different types, torque wrench, grease gun, RPM tester (Thermometer), chisels different types adjustable wrench, pliers - different types, etc.

Safety: Hazards involved in using hand tools and equipment.

Task Analysis

Time: 4 hrs
Theory: 2 hrs
Practical: 2 hrs

Task No: **2** Apply general safety rules

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7.	Define safety. Define accidents. List out the possible causes for accident. Describe the safety rules. Discuss the different types of safety. Provide general safety rules. Provide first aid in case of accident.	**Condition (Given):** In work shop. **Task (What):** Apply general safety rules **Standard (How well):** • No personal injury and • No accidents • No damage of tools and equipment.	➢ Definition of safety and accidents. ➢ Types of safety. ➢ Importance of safety. ➢ Causes of accidents. ➢ General safety rules. ➢ Definition and importance of first aid. ➢ Tips to first aider.

Required tools/equipment: Mechanics tool kit, first aid kit etc.

Safety:

- Never use mushroom head chisels.
- Never store measuring and cutting tools at same place.
- Be sure that the wrench you are using is in good condition with correct size etc.

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task No: **3** perform pre-start check-up

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9. 10.	Check engine oil level. Check fuel tank. Inspect the fuel pipe. Bleed the air from fuel pump if necessary. Inspect the tappet clearance. Inspect the external nuts and bolts for tightness. Inspect the coupling and gland packing of the water pump. Check the suction and discharge hose connection of water pump. Fill the priming unit with clean water. Maintain the work area clean and tidiness.	**Condition (Given):** In real field or workshop with pump set (diesel engine and water pump) **Task (What):** perform pre-start check-up of pump set **Standard (How well):** • The engine oil should not be more than maximum level and not less than minimum level. • The work area should be clean and tidy.	➢ Grade and quality of engine oil ➢ Importance of valve tappet clearance. ➢ Importance and purpose of ➢ Pre-start check up. ➢ Effects of air in fuel system. ➢ Importance of priming water in water pump.

Required tools/equipment: Open-end spanner-set, screwdriver (-).

Safety: Hazards involved in tools handing.

Task analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task no. **4** Operate the pump set

S.N.	Steps	Terminal Performance Objectives	Related knowledge
1 2 3 4 5 6 7 8 9 10 11	Perform all the steps of pre-start check up. Add engine oil, fuel water if required. Adjusted tappet clearance if necessary. Check the flywheel is rotate freely. Insert the cranking handle. Lift the de-compressor lever. Rotate the handle till the flywheel attains a good speed. Release the de-compressor level. Start the engine. Adjust the idle speed. Stop the engine.	**Condition (Given):** In a real field or workshop with a pump set in operating condition. **Task (What):** Start the pump set **Standard (How well):** • The pump set is started with good sound at idle speed. • According to performance guide.	➢ Importance preliminary inspection. ➢ Function of de-compressor lever. ➢ Safety rules. ➢ Idle speed.

Required tools/equipment: Starting handle, mechanics hand tools set.

Safety:

- Never loose the staring handle from hand.
- Remove the handle from engine immediately after starting the engine.
- Never use the de-compressor lever to stop the engine.

Task Analysis

Time: 5 hrs
Theory: 1 hrs
Practical: 4 hrs

Task No: **5** Service air cleaner

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1 2 3 4 5 6 7 8 9 10	Unscrew the wing nut. Remove the air cleaner cover. Remove the air filter element. Inspect the filter element. Unscrew the air cleaner mounting clamp. Drain the oil (if the cleaner is wet type) Clean the bowl or air filter housing and filter element. Refit the filter element and air cleaner. Fix the air cleaner assembly to the engine. Fill the clean engine oil to the air cleaner at the correct level for wet type air cleaner.	**Condition (Given):** In a pump set. **Task (What):** Service the air cleaner of a diesel engine. **Standard (How well):** • Filter element is removed. • Cleaned the air cleaner. • Filled the engine oil at correct level. • Refit air cleaner.	➢ Purpose of air cleaner. ➢ Types of air cleaner. ➢ Importance of cleaning. ➢ Effects of dirty air cleaner.

Required tools/equipment: Open-ended spanner set, flat driver, kerosene engine, cotton, new filter element, engine oil etc.

Safety:

- Never blow high-pressure air to clean the air cleaner that can seriously damage the filter element.
- Maintain the correct level of oil for wet type air cleaner.

Task analysis

Task no. **6** Service the silencer

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

S.N.	Steps	Terminal performance objectives	Related knowledge
1 2 3 4 5 6 7	Remove the silencer. Remove the exhaust pipe or manifold. Remove the carbon deposits from exhaust pipe and silencer. Scrap the deposits by scraper or knife. Clean the silencer and exhaust manifold. Allow to dry the silencer and exhaust manifold. Rafit the silencer and manifold.	**Condition (Given):** • In workshop with a diesel engine. **Task (What):** Service the silencer **Standard (How well):** • Clean the silencer exhaust manifold. • Removed the carbon deposits. • Checked the condition.	➢ Effects of carbon deposits on engine performance. ➢ Importance of cleaning. ➢ Silencer and its function. ➢ Types of silencer.

Required tools/equipment: Open-ended spanner set, scraper, knife, flat screwdriver, kerosene, cotton etc.

Safety:

- Never use sharp knife to scrap the carbon deposits that can injure you.
- Never fit the wetty silencer to the engine that can caught fire

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task No:**7** Change engine oil

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	Loosen the drain plug. Place a clean container or tray under the drainpipe. Remove the drain plug. Drain the engine oil. Remove the inspection and window covers. Loosen the oil strainer from oil pump. Clean the strainer in kerosene. Clean the sump box. Install the oil strainer in lub oil pump. Fit the inspection and window covers. Install the drain plug. Tighten the plug. Remove the rocket box cover. Top up the clean engine oil. Maintain the correct level. Refit the rocket box cover.	**Condition (Given):** In a workshop with a pump set engine **Task (What):** Change the engine oil **Standard (How well):** Drained oil completely. Cleaned oil strainer. Installed drain plug. No oil leakage. The oil level is correct level. (between minimum and maximum mark).	➢ Types purpose and uses of lubrication system. ➢ Engine oil types and grade. ➢ Function of oil strainer.

Required tools/equipment: Ring and open-ended spanner, flat screwdriver container (tray), kerosene, cotton, engine oil etc.

Safety:

- Never use loose oil. Always use manufacturer's special oil.
- Be sure the washer (gasket) within the drain plug, otherwise the oil teaks.

Task Analysis

Time: 5 hrs
Theory: 1 hrs
Practical: 4 hrs

Task No: **8** Change the fuel filter.

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1 2 3 4 5 6 7 8 9 10	Drain the diesel fuel from fuel tank. Remove the fuel filter element from filter casing. Clean the filter bowls and cover assembly. Renew the filter element. Install the fuel filter to the engine. Connect the fuel pipes. Top up the diesel fuel to the tank. Bleed the air from fuel system. Clean the work area and surrounding. Check for leakage.	**Condition (Given):** • In a workshop with pump set. **Task (What):** Change the fuel filter. **Standard (How well):** • Filter cleaned. • Filter element changed. • Bleed the air completely. • No fuel leakage from filter.	➢ Filter purpose and function. ➢ Types of filter and element. ➢ Main parts of fuel filter. ➢ Bleeding ➢ Effects on dirty fuel filter.

Required tools/equipment: Open-ended spanner set, flat screw driver container (tray), cotton etc.

Safety:

- **Be sure that the filter seal or o-ring should be installed properly.**
- **While bleeding the air, cover the loosed air screw by hand otherwise the air + fuel bubbles can spray your cloth and destroy.**

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task No:**9** Change oil filter

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11.	Disconnect the oil pipe form filter casing. Drain engine oil from engine. Remove the oil filter casing. Remove the filter element from casing. Clean the filter casing and sump. Install the new oil filter element in filter casing. Refit the filter casing to the engine. Connect the oil pipe to the filter casing. Top up the engine oil. Maintain the oil level. Check for leakages.	**Condition (Given):** Pump set engine. **Task (What):** Change oil filter **Standard (How well):** • Removed filter element. • Cleaned filter casing. • Renewed the filter element. • Refit the oil filter. • The engine oil should not be leaked.	➢ Filter purpose and function. ➢ Type of fuel. ➢ Effects of dirty oil filter. ➢ Filter changing interval.

Required tools/equipment: Open the ring spanner set, flat screw driver, container (tray), kerosene, cotton etc.

Safety:

- **Press the nipple of oil pipe and turn by hand to screw the pipe to avoid cross threading and oil leakage.**

Task Analysis

Time: 30 hrs
Theory: 4 hrs
Task No: **10** Dismental the diesel engine (1) Practical: 24 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1	Disconnect the water pump assembly from flywheel mounting.	**Condition (Given):** In a workshop. **Task (What):** • **Dismental / overhaul the diesel engine.** **Standard (How well):** • The detachable parts store in proper place. • The screw, nut an bolt should not be damaged.	➢ Explain the working principle of four-stroke cycle engine. ➢ Fuel system of engine. ➢ Lubrication system. ➢ Cooling system. .
2	Drain the diesel fuel.		
3	Drain engine oil.		
4	Drain cooling water.		
5	Disconnect the fuel pipelines.		
6	Removed fuel filter and fuel tank.		
7	Remove water-cooling hosepipe if fitted.		
8	Remove fuel pump.		
9	Remove engine oil pipe lines, if fitted.		
10	Remove air cleaner and silencer.		
11	Remove rocket box cover.		
12	Remove rocket box assembly.		
13	Remove push rods.		
14	Remove cylinder head.		
15	Remove cam shaft and cam follower.		
16	Remove crank case window covers.		
17	Remove connecting rod bearing cap nuts.		
18	Remove cylinder block.		
19	Remove crankshaft timing gear and flywheel.		
20	Remove flucrum pin.		
21	Remove main bearings housing and bearings.		
22	Remove crankshaft.		
23	Remove oil pump.		
24	Keep all the component in proper place.		

Required tools/equipment: Open and ring spanner set, socket wrench set, screw driver set, hammers, pullers, kerosene, container (tray), cotton etc.

Safety:

- Hazards involved in tools handling.
- Never keep heavy components above small and light parts. They can bend or damage those parts.

Task Analysis

Time: 7 hrs
Theory: 1 hrs
Practical: 6 hrs

Task No: **11** Service the rocker box assembly

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8.	Remove the rocker box assembly from engine. Inspect the condition of decompressor level. Adjust the decompressor lever if needed. Check the rocker arm bushes condition. Send the rocker arms to the machinist for replacing the new bushes. Install the rocker arms bush. Refit the rocker arms in rocker box assembly. Install the rocker box.	**Condition (Given):** • In mechanical workshop. **Task (What):** Service the rocker arm bush. **Standard (How well):** • Adjusted the decompressor lever. • Renewed the rocker arm bush. • Fit the rocker arm box assembly.	➢ Function and importance of decompressor lever. ➢ Function of rocker arm. ➢ Effects if worn rocker arm bushes. ➢ Importance of oil clearance between rocker arm bushes rocker shaft.

Required tools / equipment: Open -end spanner set, flat screwdriver, and hammer, drift punch, wooden block, machine shop equipment etc.

Safety:

- While adjusting decompressor lever, be sure that the height should be correct, excessive height adjustment can damage push rod, valve stem etc.
- No oil clearance between rocker arm bush and rocker shaft can occurs various problem in engine performance.

Task Analysis

Time: 14 hrs
Theory: 2 hrs
Task No: **12** Service the cylinder head Practical: 12hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11.	Remove the inlet and exhaust valves and its components. Detach the water inlet, outlet or blanking flange from cylinder head. Clean the water jackets and water passage. Remove carbon deposits. Clean all the components and cylinder head. Inspect the valve seat and valve guide condition. Repair or renew the valve seat and guides. Grind the valve seat by valve lapping tools. Inspect the valve spring tension and length. Assemble the valve and its components to cylinder head. Refit the cylinder head.	**Condition (Given):** A serviceable cylinder head of a pumping set. **Task (What):** Service the cylinder head. **Standard (How well):** • Removed all the carbon deposits. • The valve seats sealed properly. • No air leakage from valve seat • Oil clearance between valve guide and valve stem is correct.	➢ Compression ratio ➢ Compression leakage ➢ Effects of low compression. ➢ Valve, springs and other components ➢ Types ➢ Valve seats and valve guides.

Required tools/equipment: Open-ended spanner, valve spring compressor, valve lappings tools, grinding paste, valve seat cutter, kerosene, petrol, cotton, scraper etc.

Safety:

- While lifting the valves spring from cylinder head, handle with care, small valve key can miss and springs forces can hurt you.

Task Analysis

Time: 12 hrs
Theory: 2 hrs
Practical: 10 hrs

Task No:**13** Service the cylinder block

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3 . 4. 5. 6. 7. 8 9 10	Remove the piston assembly from cylinder block. Inspect the cylinder liner wearness. Inspect the condition of cylinder block studs. Clean the cylinder block Water jacket and passages. Measure the cylinder bore diameter. Find out the maximum wearness, ovality and tapper. Rebore the cylinder for next oversize. Replace the cylinder liner. Refit the cylinder block.	**Condition (Given):** In a workshop with serviceable cylinder block. **Task (What):** Service the cylinder block **Standard (How well):** • The water jackets must be cleaned. • Measured the cylinder bore within ±0.1mm. • Report, for the next oversize and decided correct as per manufacturer's specification.	➢ Bore stroke. ➢ Engine capacity ➢ Displacement volume ➢ Measurement ➢ Measuring instrument ➢ Inside micrometer dial gauge, telescopic gauge. ➢ Taperness, ovality. STD. And oversize of cylinder liner. ➢ Cylinder liners and its type. ➢ Oil clearance etc..

Required tools/equipment: Open-ended spanner set, measuring instruments, dial gauge, inside micrometer, telescopic gauge, cylinder liner replacing tool (liner puller) etc.

Safety:

- Be sure, to handle the precious measuring instruments, rough handing can damage the instrument.
- Precision reading (accuracy) is most important for deciding the correct size of cylinder bore.
- Wrong decision can effect the engine performance.

Task Analysis

Time: 12 hrs
Theory: 2 hrs
Practical: 10 hrs

Task No:**14** Service piston and connecting rod.

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. . 12	Remove the piston rings from piston. Clean the all components. Measure the piston diameter. Inspect the piston rings wearness. Renew the oversize piston rings. Remove the piston pin. Check the condition of small end bush and piston pin. Replace the bush if needed. Align the connecting rod's shank straightness. Measure the big-end bearing wearness. Renew the correct under size of big end bearings. Refit all the components of piston.	**Condition (Given):** • In a workshop. **Task (What):** Service piston and connecting rod. **Standard (How well):** • Replace the correct size of piston ring with out damaged. • The big - end bearing's size should be correct • As per manufacturer's specification.	➢ Function or piston and piston rings. ➢ Types of piston rings. ➢ Purpose and importance of compression. ➢ Function of connecting rod and bearings. ➢ Size of big-end bearings. ➢ Oil clearance and its effects.

Required tools/equipment: Piston-ring expounder, external micrometer, feeler gauge, plastigauge, inside micrometer, circlip pliers, kerosene, cotton etc.

Safety:

- While replacing the piston rings, use special tools, i.e. piston ring expounder otherwise, rings can be damaged.
- Never place the grooves of each ring in same line, it occurs compression leakages.
- No oil clearance or more clearance can harm engine.

Task Analysis

Time: 14 hrs
Theory: 2 hrs
Practical: 12 hrs

Task No:**15** Recondition the cam shaft

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2 3 4 5 6 7 8 9 10	Inspect the camshaft timing gear teeth. Replace the timing gear of worm / damage teeth. Check the condition of governor weight spring and pins. Inspect the governor push rod, push rod ball and pin. Inspect the cam lobe condition. Check the cam bush. Replace new bush if needed. Inspect the condition of cam follower / tappets. Inspect the push rod. Refit the all components of camshaft.	**Condition (Given):** • In a workshop with serviceable camshaft. **Task (What):** Recondition the cam shaft **Standard (How well):** • Camshaft timing gear inspected/replaced. • Measured the cam lobe. • Refit the camshaft.	➢ Valve timing, ➢ Valve timing diagram. ➢ Effects of incorrect valve timing. ➢ Importance and necessary of governor. ➢ Function of governor. ➢ Purpose and function of cam followers ./ tappets and push rods. ➢ Function of cam shaft. ➢ Cam lobes and that wearness. ➢ Effects of worn cam lobe.

Required tools/equipment: Open-ended spanner set, flat screw driver, kerosene, cotton, etc.

Safety:

- Improper fitting of governor can damage timing gear.
- Fitting of incorrect length of push rod or missed ball can not perform correctly by the governor. It can also damage engine.
- Be sure that the camshaft and timing gear are alligned properly or press fit is not loose. If fitting is loose, it can bend or damage the push rods.

Task Analysis

Time: 22 hrs
Theory: 2 hrs
Task No:**16** Recondition the crank shaft and main bearings. Practical: 20 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9 10 11 12	Inspect the crankshaft timing gear teeth. Remove the balance weights from crankshaft. Remove the oil pump drive eccentric shaft. Clean the crankshaft. Measure the crankshaft journals diameter. Find out the maximum wearness, taper and ovality. Measure the main bearing inside diameter and big - end bearing diameter. Decide for replacing correct size of bearings. Regrind or replace the crankshaft if wearness is limit. Recheck the bearings and journals. Clean the parts and crankshaft. Refit the crankshaft.	**Condition (Given):** In a workshop with serviceable crankshaft of a pump set. **Task (What):** Recondition the crankshaft and main bearings. **Standard (How well):** • Inspected timing gear. • Measured the journals diameter. • Renew the big-end and main bearings as per manufacturer's specifications.	➢ Crankshaft. ➢ Function and importance ➢ Importance and purpose of balance weight. ➢ Measuring instrument. ➢ Handling care and uses of external, internal micrometer, dial gauge etc. ➢ Oil clearance ➢ Importance and its effects.

Required tools/equipment:.Open-ended spanner set, measuring instruments external, internal micrometers, dial gauge, oil can kerosene, cotton, etc.

Safety:

- Be sure to handle the precious instrument for measurement, rough handling can damage the instrument.
- Precision reading (accuracy) is most important for deciding the correct size of bearings.
- Wrong decision can occurs unusual sound and lacks of engine performance.
- The oil gallery or hole passage should be free of dirt, and clean.

Task Analysis

Time: 13 hrs
Theory: 3 hrs
Practical: 10 hrs

Task No:**17** Service the Lub oil pump.

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9 10	Clean the oil strainer. Clean the oil pump. Inspect the eccentric strap and plunger (if the pump is plunger types) Inspect the driver and driven gear teeth (if the pump is gear type) Check the oil pump body for wearness. Measure the backlash between two gears. Inspect the lub oil pipe's hole and flare nut. Renew the plunger and pump body if worn. Assemble all the components to the pump. Refit the oil pump.	**Condition (Given):** In a workshop with a pump set engine. **Task (What):** Service the Lub oil pump. **Standard (How well):** • Cleaned the oil strainer. • Inspected pump plunger, and pump body. • Checked the gears. • Refit the pump.	➢ Lubrication system. ➢ Purpose and importance. ➢ Types of lubricating system. ➢ Main components of lubrication system. ➢ Oil pump. ➢ Purpose and function. ➢ Types of oil pump. ➢ Effects of worn oil pumps. ➢ Engine oil. ➢ Oil grades and viscosity ➢ Oil changing interval.

Required tools/equipment:.Open-ended spanner set, flat screw driver, feeler gauge, kerosene, cotton, engine oil etc.

Safety:

- All the oil Gallery, oil passages or oil hole should be clean if blocked. It will harms engine.
- Never keep the oil pump plunger here and there, it can damage of scratch the plunger that causes malfunction of pump.
- Always keep the correct grades of engine oil according to manufacturer's specification.

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task No:**18** Service the crank case.

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9 10	Clean the crankcase. Inspect if any crank is occur. Keep the oil hole or passage free from dirt. Inspect the worn or slip of stud bolts. Remove the bad studs. Change the correct size of stud bolts. Replace the crankcase if the crank is maximum Remove the gaskets or oilpaper by scraper. Clean the crankcase. Assemble the components to the crankcase.	**Condition (Given):** In a workshop with a pump set engine. **Task (What):** Service the crank case. **Standard (How well):** • Cleaned properly. • Checked for crack. • Removed broken studs. • Change the studs. • Change the studs. • Refit the components.	➢ Crank case importance and function ➢ Studs and their characteristics. ➢ Gaskets and oil paper preparation and uses.

Required tools/equipment:.Open-ended spanner set, scraper, oil can, gasket sheets, oil paper, kerosene, cotton, etc.

Safety:

- While scraping the gaskets and oilpaper, never use sharp knife that can injure you.
- Be sure that the length and size of the replacing stud should be correct and proper, otherwise they can disturb the assembly work.

Task Analysis

Time: 18 hrs
Theory: 3 hrs
Practical: 15 hrs

Task No:**19** Service the fuel injection pump

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9.	Dismantle all the components of F.I. pump. Inspect the pump elements (Barrel and plunger). Inspect the delivery valve and seat. Check the spring's tension. Clean all the parts. Assemble the parts according to performance guide. Aligns the marks of quadrant sleeve and control rod. Replace the pump elements and delivery valve assembly if worn. Refit the fuel injection pump.	**Condition (Given):** In a workshop with serviceable fuel injection pump of diesel engine. **Task (What):** Service the fuel injection pump. **Standard (How well):** • Pump element inspected. • Checked delivery valve assembly. • Alligned the marks during assemble • Refit the fuel injection pump.	➢ Fuel system purpose and importance. ➢ Types of fuel system ➢ Components of diesel fuel system ➢ Fuel injection pump working principle.

Required tools/equipment:.Open-ended spanner set, Small flat screw driver, nail circlip pliers, diesel fuel, cotton etc.

Safety:

- Never place the pump barrel and plunger separate.
- Even small scratch can damage the pump element.
- Be sure that the marks of quadrant sleeve and control rod are coincide correctly.
- Be sure that the control helix of pump plunger is coincide the spill port of pump barrel.
- Be sure that the barrel is locked with pin correctly.

Task Analysis

Time: 8 hrs
Theory: 2 hrs
Practical: 6 hrs

Task No:**20** Service the injector

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9 10 11	Disconnect the high pressure pipe and overflow pipe from injector Remove the injector from cylinder head. Overhaul the injector. Inspect the components. Clean all the parts with clean diesel only. Change the nozzle element if worn (or damaged) Assemble the injector's parts with correct order. Test the injector Adjust the pressure if required. Install the injector in cylinder head. Tighten the nuts. Connect the high-pressure pipe and overflow pipe to the injector.	**Condition (Given):** In a workshop, pump set with serviceable injector. **Task (What):** Service the injector. **Standard (How well):** • Injector serviced as per manufacturer's specification. • The injection pressure should be 150 to 190 PSI..	➢ Injector function and working pinciple ➢ Parts name ➢ Types of injector ➢ Injection pressure etc.

Required tools/equipment: .Open - ended spanner set, flat screw driver, injector tester, injector cleaning kit, cotton. Etc,.

Safety:

- Never keep your hands under the spray of injector the pressure is so high that can penetrate skin and causes skin cancer.
- Be sure that the copper washer is not missing during the installation of injector

Task Analysis

Time: 26 hrs
Theory: 2 hrs
Practical: 24 hrs

Task No:**21** Assemble the diesel engine

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1	Install the oil pump fulcrum bracket		
2	Mount the crankshaft.	**Condition (Given):**	➢ Assemble ➢ Process and procedure ➢ Rules
3	Replace the balance weight.		
4	Fit the main bearing and bearing housings.		
5	Rafit the flywheel.	In a workshop with a pump set (diesel engine)	
6	Install the piston and connecting rod to the cylinder block.		
7	Install the cylinder block to the crankcase.	**Task (What):**	
8	Place the big - end bearing caps and tighten the cap nuts.		
9	Place the cam followers (tappets) to cylinder block and hold it.	Assemble the diesel engine components.	
10	Align the timing marks and install the camshaft.	**Standard (How well):**	
11	Lock the can shaft.		
12	Fit the window and inspection cover with oil filter (if fitted).	• Assemble the components • Rotate the flywheel freely • Adjust the gap as per specification.	
13	Install the cylinder head and injector.		
14	Place the push rods.		
15	Refit the air cleaner and silencer.		
16	Install the rocker box assembly.		
17	Fit the fuel filter, fuel tank and fuel injection pump.		
18	Connect the fuel pipe lines and oil pipes.		
19	Adjust the tappet clearance.		
20	Fill the engine oil.		
21	Connect the water flange and hosepipe.		
22	Start the engine and set the idle speed.		

Required tools/equipment: .Ring spanner set, open - ended spanner set, piston ring compressor, flat screw drivers, torque wrench, oil can, cotton etc.

Safety:

- Tighten the nuts and bolts according to manufacturer's specification. Overtighten means damage the bolts and parts.
- Lubricate all the moving components during assembly work.
- Align the correct timing marks and adjust the tappet clearance according to specification provided.

Task Analysis

Time: 10 hrs
Theory: 2 hrs
Task No:**22** Adjust the tappet clearance Practical: 8 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1 2 3 4 5 6 7 8 9 10	Remove the rocker box cover. Turn the flywheel slowly till both the values are closed in compression stroke. Coincide the TDC mark (T) on the flywheel to the pointer. Check the tappet clearance. Adjust the clearance if required. Loosen the lockout and turn the adjusting screw turn the adjusting screw clock wise if the clearance is more. Turn the adjusting screw anticlockwise if the clearance is less. Measure the clearance by feeler gauge. Tighten the lock nut. Replace the rocker box cover with gasket.	**Condition (Given):** In a workshop with engine. **Task (What):** Adjust the tappet clearance **Standard (How well):** • Tappet clearance adjusted. • Clearance should be 0.20 mm +0.05mm for inlet valve and 0.25+0.05mm for exhaust valve or as per manufacturer's specification.	➢ Tappet clearance definition and importance. ➢ Causes of incorrect clearance. ➢ Effects of incorrect clearance. ➢ Compression stroke. ➢ Direction of flywheel rotation and its effects.

Required tools/equipment:.Open - ended spanner set, flat screw driver, feeler gauge, ring wrench set. Cotton etc.

Safety:

- Ensure that lock nut on rocker adjusting screw is tightened without turning the screw.

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task No:**23** Set idle speed of the engine

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9 10	Perform the pre-start check up. Stick one sticker on the flywheel. Start the engine. Run the engine 5 to 10 minutes. Measure the RPM of the engine by using tachometer. Adjust the idle speed adjustment screw and nut. Check the RPM again. Set the idle speed at 750+50 RPM. Stop the engine. Lock the adjusting screw and nut by seal thread. Inspect the performance of the engine.	**Condition (Given):** In a workshop with pump set. **Task (What):** Set the idle speed. **Standard (How well):** • Pre-start check - up performed. • Engine has started. • Idle speed checked. • Idle speed adjusted according to manufacturer's specification. • The idle speed should be 750±50RPM.	➢ Engine speed. ➢ Types of speed ➢ Rated. ➢ Max. operating ➢ Min. operating ➢ Idle speed ➢ RPM ➢ RPM tester ➢ Care and hadling techniques.

Required tools/equipment:.Open - ended spanner set, flat screw driver, tachometer (RPM tester), sticker, cotton. Etc,.

Safety:

- Handle the precious instrument carefully. Rough handling causes damage of tachometer.
- Be careful to work on a running engine.
- Never operate decompressor lever to stop the engine.

Task Analysis

Time: 5 hrs
Theory: 2 hrs
Task No:**24** Perform the routine maintenance Practical: 3 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1 2 3 4 5 6 7 8 9 10	Identify the parts to be maintained. Clean the external parts of the engine. Check engine oil. Clean lub. Oil strainer. Change fuel filter element. Change oil filter element. Adjust tappet clearance. Chang engine oil. Decarbonise the cylinder head. Silencer etc. Follow the maintenance schedule, which is provided by manufacturer.	**Condition (Given):** In a workshop with pump set engine. **Task (What):** Perform the routine maintenance. **Standard (How well):** • Performed the routine maintenance according to maintenance schedule provided by engine manufacturers.	➢ Function of different parts of engine. ➢ Routine maintenance. ➢ Purpose and advantages. ➢ Maintenance schedule. ➢ Maintenance Internal.

Required tools/equipment:.Open and ring spanner set, screw driver set, wire brush, cotton, kerosene, torque wrench, pliers etc.

Safety:

- Hazards involved in tools handing.

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Task No:**25** Maintain log book Practical: 3 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8.	Communicate with customer to conform Routine service. Perform the routine maintenance Complete work order form / job card. Estimate labour and materials cost for required services. Keep records. Manage / records on logbook. Prepare bill and receipt. Follow the logbook for next services.	**Condition (Given):** In a workshop. **Task (What):** Maintain log book **Standard (How well):** • Customer communicated. • Estimated service cost. • Prepared bill and receipt. • Record keeped. • Maintained logbook.	➢ Communication skills. ➢ Work order form of job card. ➢ Importance and purpose ➢ Log book ➢ Importance and application ➢ Estimating and costing ➢ Calculation etc.

Required tools/equipment:.Logbook, record files, pen, pencil, punching machine, job card. Work order, bill receipt etc.

Safety:

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task No:**26** Perform pre-operate check up.

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6.	Check the alignment of pump and engine. Tighteen the nut and bolts if loosed. Inspect the gland packing's condition. Check the joint between suction and delivery (discharge) pipe for tightness. Top-up the water on the pump priming unit. Lubricate engine oil or greeze on the pump parts.	**Condition (Given):** In a pump set. **Task (What):** Peform pre-operate chck up. **Standard (How well):**	➢ Alignment. ➢ Factors affective alignment. ➢ Gland packing ➢ Leakage from joints and its effects. ➢ Why lubricant is necessary.

Required tools/equipment:.Open - and ring spanner set, screw drivers, Grease gun, oil can gland, cotton, sprit level etc.

Safety:

- Hazards on handling of hand tools.

Task Analysis

Time: 4 hrs
Theory: 1 hrs
Practical: 3 hrs

Task No:**27** Align the pump with engine

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. Check the ground surface. 2. Level the ground. 3. Check the vertical and horizontal alignment of pump with engine. 4. Couple the pump with engine's flywheel. 5. Fix the rubber coupling. 6. Tighten the mounting nuts and bolts. 7. Check the alignment for confirmation.		**Condition (Given):** In a pump set. **Task (What):** Align the pump set. **Standard (How well):** • Alignment checked. • Tightened the coupling. • Nuts and bolts tightened.	➢ Alignment purposed and importance ➢ Factors affecting of mis alignment.. ➢ Coupling and types of couppling.

Required tools/equipment:.Open - and ring spanner set, sprit level, dial indicator, rubber pad, coupling etc.

Safety:

- Hazards involved in tools handling.

• Task Analysis

Time: 4 hrs
Theory: 1 hrs
Task No:**28** Pack the gland ring on pump. Practical: 3 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9.	Remove the stuffing box or gland packing cover flange. Clean the pump shaft and stuffing box. Measure the correct (exact) size of gland rings by warping around. Cut the gland rings. Prepare the gland rings by opening them radially. Keep the gland until the rings slide over the shaft. Push end ring into the stuffing box. Assemble the gland ring. Tighten the nuts by hand or using spanner.	**Condition (Given):** In a pump set. **Task (What):** Pack the gland rings. **Standard (How well):** • Stuffing box removed. • Pump shaft and stuffing box cleaned. • Exact size of gland rings were measured and cut. • Gland rings were fitted. • Gland ring were assembled • Nuts were tightened. • The pump shaft should by rotate by hand.	➢ Gland purpose and importance. ➢ Types of gland packing ➢ Bushes and pump shaft wearness.

Required tools/equipment:.Open - and ring spanner set, flat screw drivers gland packing rings, cotton etc.

Safety:

- It should be ensured that the joints of succeeding packing rings are staggered.
- Never keep excessive glands and over tighten. The nuts can promptly wear the pump shaft.

• Task Analysis

Time: 12 hrs
Theory: 2 hrs
Task No:**29** Overhaul the centrifugal pumps Practical: 10 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11 12 13	Disconnect the pump form piping system. Un couple the pump form flywheel by removing the coupling. Remove the inlet and outlet flanges. Remove the grease clip and bearing lock nut. Remove the pump drive flange. Remove the nuts and bolt joining the casing. Removing the casing slowly. Remove the stuffing box or gland cover plate. Remove the impeller nut. Dismantle the rotating unit. Remove the impeller slowly. Remove the shaft and bush form impeller. Clean the parts.	**Condition (Given):** In a workshop with water pump. **Task (What):** Dismantle the water pump from pump set. **Standard (How well):** • Piping system disconnected. • Detached the coupling. • Pump drive flange removed. • Pump casings removed. • Impeller removed. • Cleaned the components.	➢ Pump purpose and importance. ➢ Working principle of pump. ➢ Types of pump. ➢ Centrifugal pump. ➢ Stages of pump. ➢ Head calculation.

Required tools/equipment: Open - and ring spanner set, Puller, mallet and wooden hammer etc.

Safety:

- Remove the impeller slowly and gently, otherwise you will damage the impeller.

Task Analysis

Time: 5 hrs
Theory: 1 hrs
Task No:30 Service the impeller Practical: 4 hrs

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11.	Remove impeller from rotating unit. Disconnect impeller from pump drive shaft. Clean the impeller thoroughly. Remove scale, coke and other deposits from impeller by chemical cleaning or sand blasting. Inspect impeller. Check impeller's eye, vanes, shrouds, wearing, rings passages and Hubs. Recondition the impeller form corrosion, cavitation and erosion. Clean the parts again. Replace or renew the impeller. Assemble the components of impeller. Fit the impeller to pump.	**Condition (Given):** A pump set. **Task (What):** Service the impeller **Standard (How well):** • Impeller cleaned • Scale, coke and other deposits were removed. • Impeller inspected. • Impeller reconditioned. • Impeller replaced. • Refit the impeller.	➢ Impeller construction and feature ➢ Working principle ➢ Types of impeller ➢ Scale, coke and other embabed deposits. ➢ Its effects ➢ Pump performance.

Required tools/equipment:.Open - and ring spanner set, hammers, wooden or mallets, cleaning chemicals, kerosene, cotton etc.

Safety:

- Hazards involved in chemicals.
- Safety precaution of tools.

Task Analysis

Time: 7 hrs
Theory: 1 hrs
Practical: 6 hrs

Task No:**31** Assemble the centrifugal pump.

S.N.	Steps	Terminal Performance Objectives	Related Knowledge
1. 2. 3. 4. 5. 6. 7. 8 9 10 11 12 13	Clean all the components. Install the impeller and pump shaft. Refit the impeller to the rotating unit. Install the stuffing box or gland packing cover flange. Install the pump casings. Tighten the casing nuts. Install the pump drive flange. Fit the grease cup and bearing lock nut. Install the inlet and outlet flanges. Couple the pump to the engine's flywheel. Joint the piping system. Pack the gland rings. Perform the pre-operation services.	**Condition (Given):** In a pump set. **Task (What):** Assemble the centrifugal pump. **Standard (How well):** • The components cleaned • Pump shaft and impeller installed. • Rotating unit refitted. • Gland rings flange installed. • Pump casing installed and tightened. • Flanges were installed. • Gland rings were packed. • Pump coupled. • Refit the pump.	

Required tools/equipment:.Open - and ring spanner set, screw drivers wooden and mallet hammers, grease gun, cotton etc.

Safety:

- Hazards involved in tools handling.