By Invitation

A Study of Skill Gaps in the Informal Sector

J.S. Sodhi

An integral component of India's game changer on vocational education will be its emphasis on providing training to workers in the informal sector. These workers need to be certified and brought into the mainstream of jobs. Little is known about their proficiency in the skills in which they are employed. A pilot study was undertaken with the objective of assessing the skill gaps to enable the skill development agencies to bridge this gap. The study was carried out in five trades of Motor Mechanic, Mason, Plumber, TV repair and Carpenter. This paper reports the main findings of the study.

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Introduction

Skill gaps in industry are identified as lack of qualified trained persons as per the perspective of the employer. They could be due to inadequacy in general education levels and or due to inadequacy of technical skills. Most of the developed and the developing countries have been experiencing skills gaps as perceived by the employers. While general education has been the norm in most countries, vocational education has assumed much greater importance now as it plays a central role in building competencies of those entering the job market along with those who are already employed. In that sense, it is the main factor contributing to the efficiency and economic growth of a nation.

While many developed economies have given primacy to vocational education to develop competencies, an OECD study (www.org/edu/learningfor jobs) found that it has tended to remain separated from the markets, except in Germany, and has created in the past more gaps between the needs and the available skilled workforce. UK, in particular, followed a model in which primacy was given to general education as a means of

imparting technical education. General education and vocational education in UK have also followed separate trajectories where as in Germany these two have been highly integrated. The UK and the German models led to higher proportion of youths with higher levels of general education in the former and those with higher skills in the latter.

In view of the fast paced technological advancements since the 90s, UK as well as some of the other European countries have overhauled their vocational training structure since 2000 to meet the emerging needs of skills in their respective countries

How much has been the role of the government in vocational education has been a matter of debate impacting the outcomes of technical training (Greinert, 1998; Green, 1995; Nelson, 2007; Niemeyer, 2007 as in Pilz, 2012). The available models have been categorized in to the state led model and the market model. The latter has been seen to be an impediment to providing the desired vocational training as the companies train only as per their needs. The state led model has mixed results. While Germany offers the best example of the state led model in which it provides the legal framework, it involves the companies and the power to provide training is devolved to them. In company vocational training on the one hand and the wholly school system, on the other is the hallmark of the German dual system of vocational training (Sussane & Pilz, 2009). France's vocational education system is also state dominated but rooted in schools and colleges. UK's new revamped system provides vocational education in separate vocational institutes.

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Australia provided vocational education both by the government funded institutes as well as the private operators although the number and quantum of youths trained in the former have been declining over the years. The private operators have to follow the national learning framework consisting of Australian training framework, Australian qualification framework and industry training packages. The content of vocational training framework is theoretically decided by industry and not by the government or the training providers. Australia also has Industry Skill Councils and the package is owned by one of the councils.

Despite persistent efforts, most of the developed economies of the world and Europe are experiencing both the quantitative and the qualitative mismatches. There are fewer workers available on the one hand and their skills do not match with those required in the market on the other.

Skills Landscape in India

The working-age population in India is 700 million out of the total population of 1.2 billion (as in 2012). Of these 700 million, only 200 million are graduates. 58% of the population is below the age of 30 years.

India has a long history of providing vocational education. Craftsmen Training Scheme was initiated in 1950 by establishing government owned Industrial Training Institutes (ITIs) for imparting skills in various vocational trades to meet the skilled manpower requirements. The set up was supplemented by the privately owned Industrial Training Centers (ITCs) and the Craftsmen Training in schools. As of 2012, there were 4647 ITIs and ITCs in the country. These schemes have been under the jurisdiction of Ministry of Labor and Employment. Additionally, the Ministry of Human Resource Development provides vocational education in schools to standard VIII and above students. Over the years, vocational education has been supplemented by a host of other ministries and today there are 17 ministries providing vocational education in various trades. Until about four years back, the schemes remained government led as it formulated the policy, laid down standards and other parameters of vocational education.

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While this set up of vocational education has been in operation since the fifties, questions began to be raised about its efficacy to meet the demands of industry. During the last decade, labor market imperfections emerged as India witnessed a near zero employment growth with high rates of GDP growth. It emerged that there are huge skill gaps among those trained in the vocational training institutes and those required by the employers.

The Ministry of Labor commissioned a study by ILO (Gusskov, 2003) to find out the efficiency of vocational education in India. The study which was conducted in three Indian states of Andhra Pradesh, Orissa and Maharashtra found that the efficiency of the systems has been hampered by the fact that these institutes have been imparting training in accordance with the industrialization pattern of the country which in view of the inward looking policies of the government did not put pressures on industry. ITCs, which were larger in numbers, were covering even lesser number of trades than the governments run ITIs. While India adopted the export oriented industrialization since the 1990s, there was very little change in the number of trades or the quality of training being imparted in these institutes. The study also found that there was a lack of demand by the students as well as the employers to hire those trained in these institutes. About 41%, 35% and 16% of passed out students from the technical training institutes were not able to get any type of employment in Andhra Pradesh, Orissa and Maharashtra respectively.

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Some other prominent issues of vocational education and skill development are as follows:

- The total current capacity in skill development under various government schemes is not more than about 5 million per annum. The market requirement is 6 times more but the government's efforts are not sufficient to bridge neither the existing the skill gap nor the 12.8 million per annum entrants to the workforce.
- It is estimated that by 2022, India would have a skill gap of almost 250 million across the 21 key sectors. Of the 550 million people under the age of 25 years, only 11% are enrolled in tertiary institutions.
- The Sengupta Committee (2009) report had highlighted that only 2.5% of the informal sector workers have received any kind of formal training while 12.5 percent had received non-formal training. The report had proposed a scheme of skill formation and social assurance which may provide entitlements to all registered youth in the unorganized sector to receive training through placements.
- Overall, only 11% amongst the workforce have received any vocational education. However, formal training has been received by 1.3% of the workforce compared to 92% in Korea, 80% in Japan, 77% in Germany, and 80% in Canada. Even in Mexico, 24% of the workforce has been formally skilled. 82% did not receive formal training (Planning Commission 2007-12).
- Additionally there is the geographic mismatch where the demographic dividend will occur in states with backward labor market ecosystems and most employment opportunities will arise in sectors where people have very little experience (Teamlease, 2009)
- There is complete inconsistency in the kind of vocational training or education that is provided in India, across educational institutions and sectors. The programs are diverse with respect to their duration, target groups, entry qualifications, testing and certification, curriculum etc. Learning is more towards academic education rather than vocational education in the vocational education institutes.
- There is huge social taboo to enroll in vocational colleges as India never provided a qualification framework. A technically trained person joins as a worker and remains there throughout his life. Vocational training is, therefore, considered much inferior as compared to academic education leading to low enrolments for VET.
- Quality of vocational education has been very low.
- India spends less than 2% of its budget in education and only a very small part is invested in vocational schools. About 40 % of the school going children are illiterate and the dropout rate at the school level after Class 8 is extremely high.

- Companies are not willing to invest in their employees for fear of being poached by competitors.
- India's education system is more input based and focuses more on knowledge building rather than on skill building.
- There is no shared understanding in industry of what is a skilled and a semi-skilled worker.
- A large number of ITIs and ITCs are located in isolated pockets and not integrated with industry. In such institutions, half the seats lie vacant as the children coming from rural background do not fulfil the minimum qualification of even the 8th, 10th or 12^{2th} standard pass.

Vocational Education Policy

Based on these and other inputs, the Government of India has undertaken a major initiative in setting up a massive skill development program of providing vocational education to 550 million by 2022. It has set up a National Skill Development Mission in 2009 with the following administrative set up.

The Skill Development Mission consists of a three tier structure.· National Council on Skill Development, an apex body, set up under the Chairmanship of Prime Minister, for policy direction and review of skill development efforts in the country. It would be concerned with vision setting and laying down core strategies.

- National Skill Development Coordination Board (NSDCB), set up under the Chairmanship of Deputy Chairman, Planning Commission to coordinate actions of skill development both in the public and the private sectors and enumerate strategies to implement the decisions of PM's National Council.
- National Skill Development Corporation (NSDC), a not- for- profit organization in PPP mode (49% equity of Government of India the balance 51% of the private sector). It will coordinate private sector initiatives in the skill development sector and provide vocational education to 150 million persons. The rest will be trained at the initiative of the government.
- Some other key policy initiatives under the skill development mission is the formulation of National Vocational Educational Qualifications Framework (NVEQF) with the basic objective of integrating vocational and general streams of education. It sets common principles and guidelines for a nationally recognized qualification system, covering schools, vocational education institutes and institutes of higher education with qualifications ranging from secondary to doctorate level, leading to international recognition of national standards. Students would have the scope for vertical and horizontal mobility with multiple entry and exits. The framework would link schools, vocational and university education qualifications into one national system. In that sense the basic distin-

guishing feature of the scheme is that it provides students multi-level entry/ exit system that enables them to seek employment after class XII and re-join the stream as and when required to upgrade their qualification.

- Setting up of Sector Skill Councils (SSCs) which are state-sponsored employer led organizations under the mandate of NSDC. These have been created to generate a knowledge database through research and skill gap studies at the national, state, district and sectoral levels as well as a labor market information system(LIMS) for the country.

The policy package is comprehensive and marks a total paradigm shift not only in terms of up-scaling the efforts and the infrastructure but also involving the private players in a big way. Apart from setting up the NSDC, the private sector has been provided avenues to identify competencies, set up competency standards, design syllabi and curricula and utilize the infrastructure of ITIs and ITCs for provision of training and incentives for private sector investment in getting trained workers as per their needs.

Skill development initiatives of the government are also being completed by the industry organizations, in particular the Federation of Indian Chambers of Commerce & Industry (FICCI) and the Confederation of Indian Industry (CII)

The experience of the last four years, since the paradigm change in vocational training took place, has not been very encouraging. The total thrust of the program is demand based and supply side is rather neglected. There are qualitative and quantitative data gaps on the landscape of those who have to be provided training and in which trades. NSDC has taken up studies in large number of states to create this data base yet so much remains to be done. Industry has taken up upgrading the existing ITIs along with their own initiatives and these are providing market based training but their numbers are too small. SSCs have still to be formed in number priority sectors as envisaged. NVEQF was launched on a pilot basis in 2012 and is at a nascent stage. While the number of it has doubled over the last five years, it is able to create a capacity of about 5 million per-annum and the need is to enhance this capacity by over six times. As a result unemployment amongst the youth continues to rise. During 2004-05 to 2011-12 employment grew only by 0.5 percent (Sharma, 2014).

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The debate on vocational education needs to take note of the fact that 93% of the 460 million workers are in the informal sector. Large segments of them are working as self-employed and take employment in sectors like construction, agriculture, manufacturing. Over 70 % of the labor force in the age group of 15-59 years has studied up to standard VIII. 29% percent were illiterate, 24% had attained an education level of Standard IV and below and 18% up to Standard VIII (NSSO,

2009-10). Bulk of them is working in the informal sector. These workers are employed on the basis of some skills which they have acquired either through their family or working on the job. They work in low paid insecure jobs in view of lack of formal vocational training.

An integral component of India's game changer on vocational education will be its emphasis on providing training to workers in the informal sector. These workers need to be certified and brought into the mainstream of jobs. It is, therefore, obvious that any training endeavor has to integrate them fully in its program of vocational education.

The Study

Informal sector workers may not require total inputs as they have already been working and have acquired some skills. However, little is known about their proficiency of skills or lack of it. A study of this nature will help millions of aspiring and already engaged workers to acquire formal skills in the context of the present and the future needs

A pilot study was undertaken with the objective of identifying the present level of skills and assess the skill gaps to enable the skill development providers to bridge this gap. The study was carried out in five trades of Motor Mechanic (Automobile/Auto Component) in Ludhiana-Punjab, Mason (Building & Construction) in Noida-Uttar Pradesh, Plumber in Gurgaon, TV repair (Electronics Hardware) in Gurgaon in Haryana and Carpenter (Building &Construction) in Noida, Uttar Pradesh. In each trade, 100 workers were interviewed with the help of a specially designed questionnaire enumerating the total component of skills required for each trade.

Findings & Implications

The study results provide information about which not much is known as there are fewer studies on the subject. NSDC has done a few studies but more on the quantitative skill gaps.

In terms of their background information the study found that most of the respondents belonged to the younger age group (16-35years) with the implication that such workers are going to be in the labor market for over two decades. A higher proportion of them studied up to the eight standard with more of carpenters and masons being illiterates or studied up to the primary level. These workers will not be able to attain vocational education in the formal streams. Most of the respondents, except for the Motor Mechanics, were willing to undertake formal training to bridge their skill gaps. Majority wished to take up part time training and very few opted for the formal sources of training.

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The respondents were also not able to invest much time on further training as most of the Masons and Plumbers opted for training up to 30 days while others opted to undertake training for up to 100 days (Tables 1-9).

Table 1 Age Groups of the Respondents

(Fig. in %)

Sl. No	Age / Trade	15 - 20	21 – 25	26 - 30	31-35	36-40	41-45	46-50	51-55	55 & above
1.	Motor Mechanic	4	30	18	17	16	8	7	-	-
2.	Mason	17	15	23	18	8	7	12	-	-
3.	Carpenter	16	44	17	15	5	2	1	-	-
4.	Plumber	9	46	24	13	6	2	-	-	-
5.	TV Mechanic	76	20	4	-	-	-	-	-	-

Table 2 Average Number of Days Employed in a Month

(Fig. in %)

No. of	Days / Trade	Up to 15	16 – 20	21 – 25	26 – 30
1.	Motor Mechanic				
2.	Mason	-	12	24	64
3.	Carpenter	7	12	45	36
4.	Plumber	4	21	46	29
5.	T.V. Mechanic				

Table 3 State wise of Origin of the Respondents

(Fig. in %)

	State /Trade	U.P	Bihar Bengal	West	Punjab	Uttra khand	Haryana	Orissa	Jhar khand	Others
1.	Motor Mechanic	4	-	-	91	-	-	-	-	5
2.	Mason	44	15	19	-	-	-	-	10	12
3.	Carpenter	57	-	-	-	2	29	-	-	14
3.	Plumber	39	15	-	-	-	11	-	19	16
4.	T.V. Mechanic	2	-	-	-	-	98	-	-	-

Table 4 Level of Education of the Respondents

(Fig. in %)

	Education Level / Trade	Illiterate	Up to V Std.	Up to 10 Std	11th Std. & Above
1.	Motor Mechanic	3	7	41	49
2.	Mason	37	22	27	14
3.	Carpenter	19	13	45	23
4.	Plumber	29	6	54	11
5.	T.V. Mechanic	-	4	36	60

Table 5 Average Monthly Income of the Respondents

(Fig. in %)

	Monthly Income Trade	RS.0-5000	RS.5000-10000	RS.10001-15000	RS.15001 & Above
1.	Motor Mechanic	11	23	16	25
2.	Mason	7	67	12	14
3.	Carpenter	7	68	21	4
4.	Plumber	12	60	24	4
5.	T.V. Mechanic	6	26	26	32

Table 6 Average Monthly Income of the Family

(Fig. in %)

	Monthly Income. Trade	0-5000	5000-10000	10001-15000	15001 & Above
1.	Motor Mechanic	5	28	20	47
2.	Mason	7	46	20	23
3.	Carpenter	4	39	15	42
4.	Plumber	3	16	24	57
5.	T.V. Mechanic	6	26	16	52

Table 7 Willingness to Undergo Training

(Fig. in %)

	Willingness Trade	YES	NO
1.	Auto Mechanic	53	47
2.	Mason	93	7
3.	Carpenter	95	5
4.	Plumber	91	9
5.	T.V. Mechanic	98	2

Table 8 Institution from Which Willing To Undergo Training

(Fig. in %)

	Institution Trade	NIOS	ITI	Part Time(Anywhere)
1.	Motor Mechanic	9.4	24.5	72.1
2.	Mason	12.9?	31.2	56.9
3.	Carpenter	9.5	26.3	65.2
4.	Plumber	7.9	6.7	85.4
5.	T.V. Mechanic	10.9	21.7	67.4

Table 9 Desired Number of Days of Training

	Training days / Trade	Up to 10	Up to 20	Up to 30	Up to 100	100 days & More
1.	Motor Mechanic	9.4	18.9	20.6	26.4	5.7
2.	Mason	-	12.00	88.0	-	-
3.	Carpenter	4.2	12.5	21.1	24.2	6.0
4.	Plumber	3.3	29.7	56.0	4.4	6.6
5.	T.V. Mechanic	5.7	7.7	12.2	35.6	31.9

Skill Gaps

Motor Mechanic: The training duration for getting formal certification is entirely a function of the skill gaps. However, the policy makers would also need to orient the curriculum from the perspective of persons wishing to enhance their skills. The data on skill gaps shows overall there was a gap of 48% in their competence of the trade. More specifically, about two thirds had nil or negligible competence of the main parts of and the units attached with the engine of a motor vehicle. Two thirds also had nil or negligible competency about other aspects like 'meaning of stroke', 'functions of cylinder' and 'components of full supply in diesel engine'. 49% did not have knowledge of the ignition system. Further, 36% of the respondents had nil or negligible competency regarding the 'merits & demerits of the two stroke engine'. One-fourth did not have any competency of the difference between "two strokes and the four Strokes engine". On other aspects like 'thermostat' 'battery' 'reasons and remedies of the injector pressure' a higher proportion of respondents had no/ negligible competence. While there are competency gaps most of Motor Mechanics were unwilling to take up further training

Masons: Their competency levels were checked on aspects like tools, bricks, cement, mortar, masonary technical terms & safety precautions. Their overall competency gap of all these aspects was 55%. About half or more did not have the competence of various masonry terms, tools & knowledge of storage of cement and ratio of various ingredients of mortar. Sixty percent of them also did not have any competence of the safety precautions to be taken up while on the job. Most of them were willing to take up further training to bridge the skill gaps.

Carpenter: Their competence was seen on aspects like knowledge of distinction between soft and hard wood, distinction between various units of measurement, knowledge of carpentry technical terms, bugs and worms, tools and instruments and safety precautions. Overall, there was a gap of 39% in their knowledge of various aspects of their trade. The competence gap was the highest on safety norms as about two-thirds had nil or negligible knowledge of this aspect. About half of them also did not

have any knowledge of soft and hard wood and tools and instruments like caliper, compass, etc. Over two-thirds had knowledge of bugs & worms and technical terms of their trade.

Plumbers: The competence level was drawn out on plumbing terms & systems, conversion of units from FPS to MKS, dimensional tolerance while assembling GI pipes and bending & threading pipes. Overall there was a skill gap of 44% in their knowledge. More specially, about one-fifth had nil or negligible competence of bending & threading pipes, over two-thirds had nil or negligible competence of the conversion of units from FPS to MKS and of dimensional tolerance while assembling the GI Pipes. 39% of the plumbers did not at all know the reasons for overflowing from cistern as well as the method of stopping them.

Most of the respondents showed their willingness for training.

TV Mechanic: Competence levels were assessed on their knowledge of resistance, finding typical faults, instruments, Wattage and replacing defective parts like transistor, Diode & IC from PCB. Overall, there was a skill gap of 48% amongst the TV Mechanics. 30% did not have any knowledge of various measuring instruments and 28% have no knowledge of Wattage of Electric Soldering iron. There were gaps in competence of finding specific faults (38%) and resistance (48%). All of them were willing to take up additional training.

Conclusions & Policy Implications

At the macro level India followed the British model in which higher education per se was given preeminence despite the fact that it had built a structure of vocation education in the 1950s. This remained mostly government controlled till 2008 and without the involvement of industy thus not integrating the needs of industry.

With the economic liberalization of the nineties, the gap between the acquired and the desired level of skills widened thus creating a paradox of high unemployment of the technically trained persons and industry facing a severe shortage of the skilled manpower.

The Government of India began an ambitious programme of vocational education in 2008. The complexity of the task is making it much tougher for the policy makers to move forward with the desired speed.

In the Indian context, there is the existence of a large informally trained workforce whose skills are inadequate. They are largely unable to access the formal channels of vocational education stream in view of their low education levels and the fact that they are main bread earners of their families. Such persons need to be trained close to their place of work through part time capsules especially developed for them. However, according to the present data base information about specific skill gaps is not available in any systematic manner.

The paper presents succinctly the findings of a study to understand the com-

petency levels and skills gaps of technical persons in five trades.The policy implications emerging from the study are as follows.

The skill gaps identified through the study (Annexure I) would help the policy makers to design a curricula for bridging these gaps. However, it is important to state that curriculum development can be applicable unless more such studies in different regions are undertaken to help standardize a curricula based on skill gaps.

The study results show that despite skill gaps willingness of such workforce to take up further training cannot be taken for granted. For example while most of Motor mechanics had skill gaps they showed their unwillingness to take up further training. This finding has two kinds of implications. One there has been a lot of debate on the absolute numbers of persons which would require vocational training. The figure of training 500 million persons has been arrived simply by projecting the number of persons who are and will enter the labor market till 2022 and the assumption that all of them will require vocational education. Second, the unwillingness of the technical persons raises the basic question of leaving them alone with the present level of skill gaps or to take a call on giving them further training. It is important that the policy makers make an effort to understand of the present gaps of such persons and build some incentives considering that they are going to be in the labor market for over two decades and their present level of skills would become obsolete due to technological advancements in the years to come. The training capsules thus developed would have to be imparted through part time mode as also of the duration which is in sync with the availability of such persons.

The policy on skill development needs to take note of the two distinctive features of the education level of the respondents. One relates to those in informal sector who are either illiterate or have studied up to the primary level & the other for those who have studied up to the tenth standard or above. The former group needs to be trained in non-formal manner as the formal channeals of acquiring skills (the ITIs & ITCs) requires a minimum educational qualification of ninth standards and above. The latter groups of respondents are eligible to take recourse to enhancement of skills through the formal channels.

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Annexure I. Curriculum for Bridging Skill Gaps

Motor Mechanics

- Various parts of a vehicle and their respective locations.
- The technical difference between 2/4 stroke engines.
- Petrol/Diesel/CNG engines.
- The working procedure and purpose & types of clutch, gearbox & brakes.
- Various dos & don'ts to be followed while repairing and maintaining various vehicles.
- The procedure for checking compression pressure.
- The system of power of flow from engine to wheels.
- The working principles of drums and disc brakes.
- The fluid to be put in a battery and its proper maintenance.
- The procedure for dismantling and reassembling after maintenance of clutch, gearbox & brakes.
- The tyre sizes and reasons for their general defects.
- The need & procedure of tyre rotation.
- The air-fuel ratio.
- Various tools & instruments and their usage for maintenance of vehicles, specifically micrometer, feeler gauge, multi meter & dial gauge etc.
- Emission norms.
- The series & parallel resistance circuits.
- Need to learn the procedure for checking and overhauling suspension system.
- The working principle, procedure for dismantling, inspecting & assembling of start motor.
- Need to learn about the safety precautions to be observed in workshop/garage.

Masons

- Various masonry tools, their storage and correct usage.
- The quality of masonry material and their technical specifications.

- Adequate storage of material.
- The timing of initial and final setting of cement.
- The quality of paste of cement.
- Ratio of cement and sand of making mortar for various purposes.
- The technical terms related to masonry work.
- To deal with the left over mortar.
- To assess the quantity required of various materials for a specific work
- Ability to calculate the quantum of work done or to be done.
- The safety procedures and gadgets/instruments need to be used for safety purposes.
- The modern housekeeping practice, handling of materials and waste disposal.

Carpenters

- Carpentry tools, holding devices, and machines and their usage for various jobs.
- To draw a rough sketch of a job.
- To identify, qualities and usage of various types of hard/soft woods like deodar, shisham etc.
- The preservation of the wood.
- Converting FPS (Foot, Pound, Second) system to MKS (Meter, Kilogram, Second) system.
- Seasoning of wood and its methods.
- Various other carpentry materials and their quality.
- The worms that damage the wood, chemicals to be applied to wood to prevent from damage by the various worms.
- Assessing the quantity of material required for a particular job.
- Assessing the work done or to be done.
- Procedures and gadgets/instruments need to be used for safety purposes.

Plumbers

- Various plumbing tools and their usage.
- Various plumbing materials and their usage.
- Various types of pipes and their usage.
- Cutting the various types of pipes.
- Threading the GI pipes.
- Cutting, bending and jointing of PVC pipes.
- Fixing sanitary fitting, kitchen fittings and W.C. fittings.
- Various types of urinals and their fittings.
- Fitting the water meters in main pipe lines.
- Fitting the water pumps.
- Assessing the quantity of material required for a particular job.
- Safety procedures and safety tools and equipments to be used for safety purposes.
- Housekeeping practices.
- Storage and maintenance of the plumbing tools.

TV Mechnics

- Various instruments used for TV repairs such as:

➢ Moving Coil Meter

➢ Ammeter.

➢ Voltmeter.

➢ Ohmmeter

➢ Digital Multimeter.

➢ Multimeter.

➢ Pattern Aenerator.

- Cathode Ray Oscillator.
- Frequency Counter.
- R.F. Signal Generator.

• Technical knowledge of:

- Factors affecting Resistance.
- Resistance colour codes.

• Inductance:

- Mutual inductance.
- Types of coils.
- Combination of Inductance.

• Capacitor:

- Working of Capacitor.
- Factors affecting Capacitor.
- Types of Capacitors.
- Combination of Capacitors.
- Color coding.

• Transformers:

- Working of transformer.
- Voltage Ratio.
- Current Ratio.
- Step up & step down transformer.
- Auto transformer.
- Advantages & disadvantages of transformers.

• functions of:

- Microphone.
- Rectifier.
- Loud speaker.
- Video signals.
- Detector.

• Different elements of Antenna.

• Audio system.

• Functions of Diodes/Triode etc.

• Functions of semi-conductors.

Precautions to be observed while repairing TV.