Program Name   : **Diploma in Digital Electronics**

Program Code   : **DE**

Semester   : **Fourth**

Course Title   : **Maintenance of Electronics Equipment**

Course Code   : **22035**

1.   RATIONALE

Equipment with electronic circuitry are increasingly being used in all the industries and maintenance of them is the essential work for the proper functioning of the complete system. This course will enable the diploma students to develop skills to maintain the basic electronic circuitry used in these equipments, which are employed in industries. This course will also enable them to fulfill the basic prerequisite for the advance maintenance issues which they will face in the industries.

2.   COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through various teaching learning experiences:

- **Maintain different types of electronic equipments.**

3.   COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

- a. Troubleshoot electronic equipment.
- b. Troubleshoot analog components and circuits.
- c. Troubleshoot digital components.
- d. Troubleshoot computer hardware and networking.
- e. Troubleshoot electronic home appliances.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
					Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
-	-	4	4	-	-	-	-	-	-	-	50@	20	50~	20	100	40

*(~): For the **practical only courses**, the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e. 30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 20 marks). This is designed to facilitate attainment of UOs holistically, as there is no theory ESE.*

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment, '**#**': No Theory Examination

5.   COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.
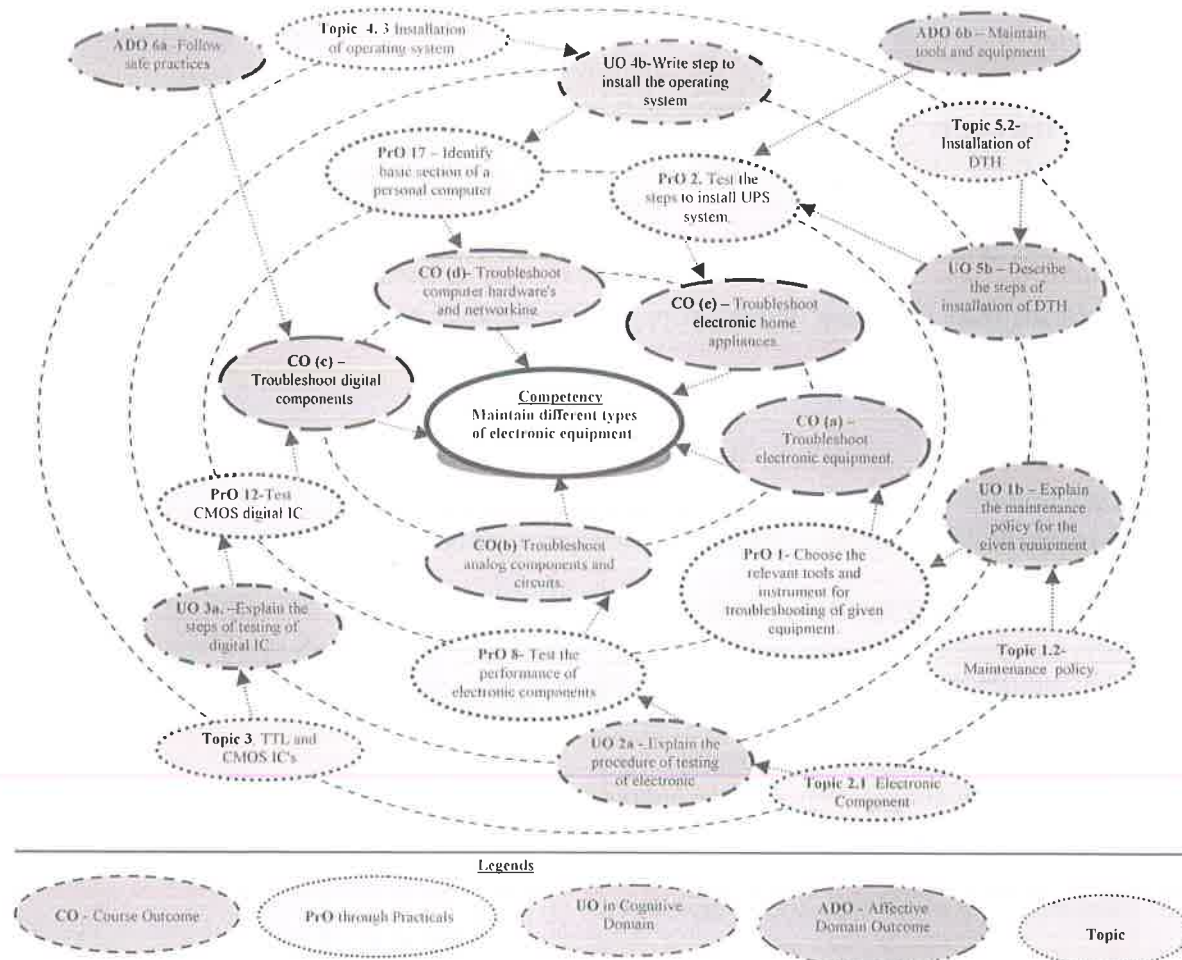

Figure 1 - Course Map

6.   SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Choose the relevant tools and instrument for troubleshooting of given equipment	I	02
2	Check the functioning of the resistor, capacitor and inductor by using multimeter, LCR meter and CRO.	II	02
3	Check the functioning of the Transistor by using multimeter, transistor Tester and CRO.	II	02*
4	Check the functioning of the analog ICs using analog IC tester.	II	02
5	Check the functioning of the regulator ICs.	II	02*
6	Check the functioning of the ON/OFF switches: SPST, SPDT,	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	DPDT Relays, Solenoids.		
7	Check the functioning of the active electronic components like general purpose FET/MOSFET/SCR/DIAC/TRIAC with DMM or CRO.	II	02
8	Check the functioning of the electronics components: transformers, Loudspeaker, microphone.	II	02
9	Check the functioning of the electronics components: sensors, opto electronics components	II	02
10	Check the functioning of the TTL Digital IC's using IC tester.	III	02*
11	Check the functioning of the CMOS digital ICs using digital IC tester.	III	02
12	Check the functioning of the Connector (RJ 45, RJ11 etc).	III	02,
13	Check the functioning of the given data cable (IDE cable, RS232 etc).	III	02
14	Install the operating system on computer system.	IV	02*
15	Check the functioning of the WAN of computer system.	IV	02*
16	Identify basic sections/components of a mother board of personal computer.	IV	02
17	Troubleshoot the computer laser printer.	IV	02
18	Troubleshoot the computer inkjet printer.	IV	02
19	Troubleshoot the computer dot matrix printer.	IV	02
20	Test the voltage at different test points of SMPS of desktop computer system.	V	02*
21	Check the functioning of the online UPS.	V	02*
22	Check the functioning of the Offline UPS.	V	02*
23	Install a DTH receiver.	V	02
24	Check the functioning of the PA system.	V	02
25	Use the mobile trainer kit available in lab to identify different sections of mobile	V	02
26	Check the functioning of the electronic surveillance system.	V	02
27	Check the functioning of the photo copier machine available in your institute.	V	02
28	Troubleshoot the voltage stabilizer.	V	02
29	Troubleshoot the battery charger of mobile.	V	02
30	Troubleshoot the domestic water level controller.	V	02
31	Troubleshoot the emergency light system.	V	02
32	Test the steps for installation of Solar power system.	V	02
	Total		**64**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Identify the requirements of practical set up	15
2	Operate equipment skillfully	20
3	Record Observations	20
4	Submit report in time	30
5	Attendance and punctuality	15
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices.
b. Maintain tools and equipment ·
c. Demonstrate working as a leader / a team member.
d. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below

*   'Valuing Level' in 1st year
*   'Organizing Level' in 2nd year and
*   'Characterising Level' in 3rd year

7.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Dual Power supply 0- 30V, 2A	2-20
2	Cathode Ray Oscilloscope, Dual Trace 50MHz and above, 1MegaΩ Input Impedance	2-20
3	Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude	3-5,11-13
4	IC tester: Tests a wide range Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	8
5	Personal Computer, 4GB RAM, 500GB HDD , higher Processor	21-33

8.   UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Maintenance management and troubleshooting	1a. Explain with sketch the steps of the given electronic equipment maintenance. 1b. Explain the maintenance policy for the given equipment. 1c. Choose the service option for the maintenance of the given equipment with justification 1d. Describe the software installation procedure for the given equipment. 1e. Describe the procedure to troubleshoot the specified equipment.	1.1 Objectives of maintenance management; Service and maintenance laboratory 1.2 Maintenance policy: Concept of Warranty and guarantee; Equipment service options 1.3 Interpreting the service and operation manuals 1.4 Troubleshooting process 1.5 Fault finding tools and instruments 1.6 Troubleshooting techniques and measures 1.7 Software Installation procedure and policies.
Unit-II Maintenance of analog component and circuit	2a. Explain with sketch the procedure for testing the given electronics components. 2b. Describe with sketch the steps for continuity testing of given electronic components. 2c. Write steps for finding faults in the given non working circuit. 2d. Explain the steps to rectify faults in the given electronic circuit. 2e. Describe the procedure to troubleshoot the specified analog equipment	2.1 Various specifications of electronic components (active/passive) and different types of ICs using data book. 2.2 Testing of passive components separately or mounted on PCB like: resistor, capacitors, switches, inductors, relays, transformers, fuses, connectors, single/three phase miniature circuit Breaker (MCBs), single phase Earth Leakage Circuit Breaker (ELCBs), 2.3 Testing of all kind of active electronics components separately or mounted on PCB using DMM or CRO like: diodes, transistors, FETs, MOSFET's, SCR, DIAC,TRIAC, displays using LCD or LED , opto electronics components, crystal 2.4 Continuity test of PCB track, wiring, switches 2.5 Test the ICs connected on given PCB

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit III Maintenance of Digital component and circuit	3a. Explain the steps to test different types of digital ICs. 3b. Explain with sketch the procedure for testing of the specified data cables. 3c. Explain with sketch the procedure for testing of the specified connectors. 3d. Explain with sketch the procedure for testing of the given Ethernet HUB or switch. 3e. Describe the procedure to troubleshoot the specified digital equipment.	3.1 Testing of TTL and CMOS IC's 3.2 Testing and identifying the different types of data cables: Ethernet cables, coaxial cable, serial and parallel cables, telephone cable, USB cable. 3.3 Testing and identifying the different types of connectors. 3.4 Testing of Ethernet HUB or switch. 3.5 IP address setting, Ping Command, IP config command
Unit –IV Maintenance of Computer system	4a. Describe the function of specified parts of computer system with sketch. 4b. Write steps to install the given operating system software on a Computer system. 4c. Write the steps to install the given application software on a computer system 4d. Write steps to configure Add-on cards and other interfacing devices. 4e. Describe the procedure to troubleshoot the specified digital equipment	4.1 Various parts of computer system and its assembly. 4.2 Formatting of hard disk. 4.3 Installation of operating system, application software. 4.4 Installation of Add-on cards (network card/display card/multimedia card etc). 4.5 Installation of printer/scanner.
Unit– V Maintenance of electronic domestic appliances	5a. Describe common steps of maintenance of the given home appliances. 5b. Describe common steps of installation of DTH. 5c. Describe common steps of installation of solar power system. 5d. Explain steps to install surveillance system. 4f. Describe the procedure to troubleshoot the specified electronic home appliance. 4g.	5.1 Maintenance of home appliances:, battery charger, water level controller, emergency light system, SMPS , public address (PA)system 5.2 Demonstration of offline/online UPS and DTH 5.3 Installation of solar power system 5.4 Mobile hardware 5.5 Surveillance system- CCTV.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'

9.   SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN
   - Not applicable -

10.   SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journals based on practical performed in laboratory.
b. Diagnose fault in the non working equipment of home appliance and rectify that.
c. Discuss case study of any fault detection and rectification problem.
d. Maintain the office electronic equipment.
e. Search internet websites about manufacturer, specifications and cost of the measuring and testing equipments
f. Arrange visit to nearby electronic industry and prepare the report.

11.   SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
e. Guide student(s) in undertaking micro-projects.
f. No. of practical's selection to be performed should cover all units.
g. Show video/animation films explaining application of simulation software.

12.   SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three.*

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Select relevant analog electronics components and analog IC with specification for given application and prepare report.

b. Select relevant electronics components and digital IC with specification for given application and prepare report.

c. Each group will prepare Performa of logbook, preventive and corrective maintenance and data analysis(for Any one equipment in laboratory).

d. Prepare a chart related to maintenance of equipment /gadget available in the laboratory.

c. Prepare a maintenance record of UPS available in college for one semester.

d. Prepare a manual for installation of PA system to organize any event.

e. Prepare a manual to develop solar power system for domestic purpose.

f. Prepare a maintenance register to maintain the computer lab for one semester.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Trouble Shooting Electronic Equipment: Includes Repair And Maintenance	Khandpure,R.S.	Tata Mcgraw-Hill Publishing Company Limited, New Delhi ISBN-9780070483576.
2	Electronic instruments and system	Gupta, R.G.	Tata Mcgraw-Hill Publishing Company Limited, New Delhi ISBN- 9780074636299
3	Network Analysis and Synthesis	Ghosh, S.P.; Chakrabarti, A.K.	McGraw Hill Education, New Delhi, 2010. ISBN: 9780070144781
4	Computer Hardware: Installation, Interfacing, Troubleshooting and Maintenance	James, K.L.	Prentice Hall India Learning Private Limited ISBN-13: 9788120347984
5	Electronics Devices and Circuit Theory	Boylestad, Robert L.	Pearson Publication, New Delhi, 2015, ISBN: 9788131727003

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. http://www.automationtechnology.de/cms/en/markets-solutions/electronics.html

b. http://www.talkingelectronics.com

c. www.accessengineeringlibrary.com/browse/troubleshooting-electronic equipment-includes-repair-and-maintenance-second-edition#c9780070483576ch01

d. www.fixya.com

e. www.ifixit.com

f. www.fastrepairguide.com

g. www.repairfaq.org

h. www.linear.com/

i. www.easyeda.com/

j. www.circuitlogix.com/

k. www.spectrum-soft.com/