

Program Name : Diploma in Industrial Electronics
Program Code : IE
Semester : Fifth
Course Title : Data Communication Techniques
Course Code : 22539

1. RATIONALE

We are witness to the industrial revolution. In this scenario, diploma passout students should aware of the principles, procedure and application of various data communication techniques, so that they can apply the same for appropriate field. The knowledge of this course will help the students to use relevant data communication techniques to maintain various industrial process control systems.

2. COMPETENCY

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

- Use relevant data communication technique.

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:

- Identify the different types of data communication equipment and techniques.
- Use relevant digital modulation techniques.
- Interpret data communication media.
- Use fibre optics in data communication.
- Use OSI model and relevant data communication protocols.
- Maintain wireless network environment.

4. TEACHING AND EXAMINATION SCHEME

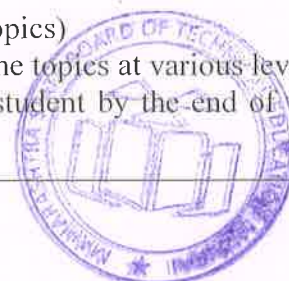
| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | | |
|-----------------|---|---|----------------|--------------------|-----|-----|-----|-----|-------|-----------|-----|-----|-----|-----|-------|----|
| L | T | P | | Theory | | | | | | Practical | | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| | | | Max | | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | |
| 3 | - | 2 | 5 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | 25@ | 10 | 25 | 10 | 50 | 20 |

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, ESE -End Semester Examination; PA - Progressive Assessment

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.

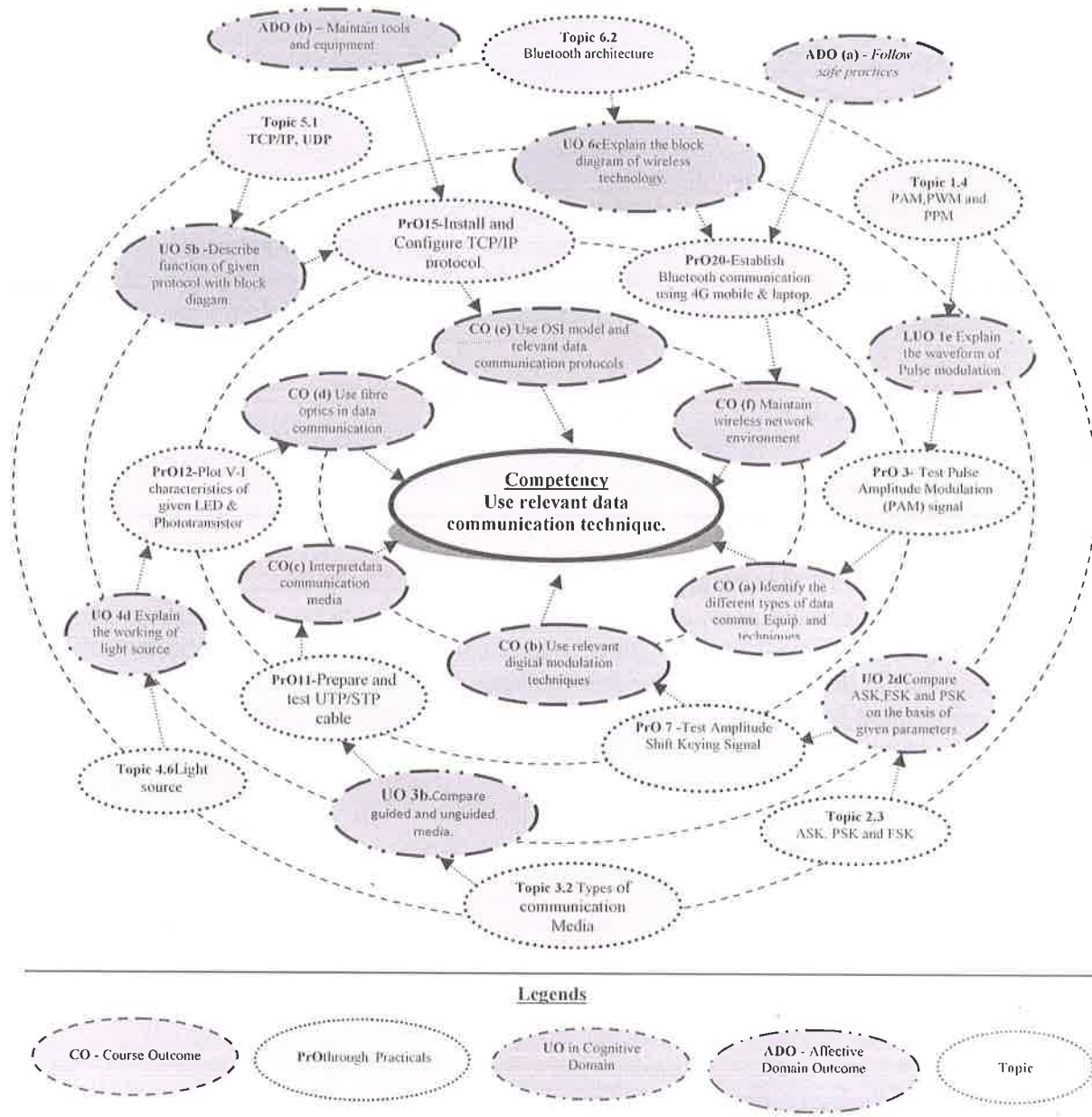


Figure 1 - Course Map

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 | Measure the modulation index of amplitude modulated wave and observe the effect of modulating signal voltage on it . | 1 | 2 |
| 2 | Measure the modulation index of the frequency modulated wave and observe the effect of modulating and Carrier signal voltage on Frequency Modulation. | 1 | 2 |



| S. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. Required |
|--------|---|-----------|-----------------------|
| 3 | Test Pulse Amplitude Modulation (PAM) signal. | I | 2 |
| 4 | Test Pulse Width Modulation signal. | I | 2 |
| 5 | Test Pulse Position Modulation Signal. | I | 2 |
| 6 | Test Pulse Code Modulation Signal. | II | 2 |
| 7 | Test Amplitude Shift Keying Signal | II | 2 |
| 8 | Test Frequency Shift Keying Signal | II | 2 |
| 9 | Test Phase shift Keying Signal. | II | 2 |
| 10 | Plot the V-I Characteristics of given Infra Red Light Source(IR-LED) | III | 2 |
| 11 | Prepare and test UTP/STP cable in straight and crossover mode and by line tester. | III | 2 |
| 12 | Plot the V-I Characteristics of given Light Source(LED) and detector(photo transistor) | IV | 2 |
| 13 | Calculate the Numerical Aperture (NA) of given 1mm. diameter Plastic optical fibre at 650 nm. using OFT trainer Kit | IV | 2 |
| 14 | Create the scenario and study the performance of token ring LAN protocol through simulation and using trainer kit. | V | 2 |
| 15 | Install and configure TCP/IP protocol. | V | 2 |
| 16 | Perform the transfer of files from PC to PC using Windows | V | 2 |
| 17 | Perform the transfer of a file from PC to another PC using Serial port RS-232 | V | 2 |
| 18 | Establish star topology using transmission media and network control device. | VI | 2 |
| 19 | Establish Wireless Communication between five computers using wireless LAN. | VI | 2 |
| 20 | Establish Bluetooth communication using 4G mobile and laptop. | VI | 2 |
| | Total | 40 | |

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 judicious 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 % |
|-------|---|----------------|
| a. | Preparation of experimental set up | 20 |
| b. | Setting and operation | 20 |
| c. | Safety measures | 10 |
| d. | Observations and Recording | 10 |
| e. | Interpretation of result and Conclusion | 20 |
| f. | Answer to sample questions | 10 |
| g. | Submission of report in time | 10 |
| | 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 safety practices.
- b. Practice good housekeeping.
- c. Practice energy conservation.
- d. Demonstrate working as a leader/a team member.
- e. Maintain tools and equipment.
- f. 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
- 'Organising Level' in 2nd year
- '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 | Function Generator :1-10MHz, Experimental kit of AM. Modulator, Digital storage Oscilloscope: Dual Trace 100Mhz , 1MegaΩ Input Impedance CRO:25 MHz | 1 to 9 |
| 2 | Output Power meter for fiber optics:-70 to 10dBm and 1mw 5km Fiber Cable Test. Experimental kit of fiber optic :with appropriate test points & connecting cords. | 10 to 11 |
| 3 | LEDs Characteristics trainer kits & discrete components, breadboards. | 12 |
| 4 | IR-LEDs Characteristics trainer kits & discrete components, breadboards. | 10 |
| 5 | Function Generator 0-2 MHz with Sine, square and triangular output with variable frequency and amplitude | All |
| 6 | Experimental Kits of PAM,PWM,PCM ,ASK,FSK, | All |
| 7 | Crimping tools , RJ-45 connectors, Different types of cables such as UTP, STP, twisted, Coaxial cable , optical fiber cable and splicing kit | 12 to 18 |
| 8 | 8 port Switch, external MODEM, Repeaters and Routers. | 12 to 18 |
| 9 | Minimum Five Personal computers with Intel Pentium Core 2 duo and Network interface card -NIC), | 12 to 18 |
| 10 | Wireless LAN device(LAN cards), 4G mobile , laptop | 19 to 20 |

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 Data Communication and Modulation | 1a. Explain with sketch the given types of communication system. 1b. Explain with sketch the working of the given modulation or demodulation technique. 1c. Classify the communication technique on the basis of given criteria. 1d. Explain with sketch the waveforms of the given pulse modulation technique with sketch, ammeter, wattmeter. | 1.1 Block diagram of communication system 1.2 Types of communication system: synchronous and asynchronous, simplex, half-duplex, full duplex, serial and parallel communication 1.3 Classification of communication technique: AM, FM, & PM on the basis of definition, waveform, bandwidth, modulation index 1.4 Pulse Modulation: PAM, PWM & PPM concepts, advantages, disadvantages and applications. |
| Unit– II Digital Modulation Techniques | 2a. Classify the given digital modulation techniques with justification. 2b. State the use of sampling and quantization process for the given 'q' levels of quantization. 2c. Explain with sketch the working principle of the given digital modulation technique with waveform. 2d. Compare the ASK, PSK and FSK on the basis of the given parameters. | 2.1 Digital Communication: Block diagram and working principle, waveforms, strength and limitations 2.2 Sampling process Nyquist sampling theorem, quantization process, quantization error, quantization noise 2.3 PCM: Block diagram, working principle, waveforms, advantages, disadvantages, application of PCM. 2.4 Principle of ASK, PSK, FSK. Application of ASK, PSK, FSK |
| Unit III : Data Communication Media | 3a. Interpret the given types of error in data communication media. 3b. Compare given media on the basis of the specified parameters. 3c. Explain with sketch the parameters properties of the given type communication media. 3d. Identify the data communication media for the given application with justification. | 3.1 Baud rate, Bit rate, types of errors in data communication and error correction techniques. 3.2 Types of communication media and frequency band of operation 3.3 Guided media: Types of cable-twisted pair cable, co-axial cable, fiber optic cable. 3.4 Unguided media: Microwave communication, Infrared communication. |
| Unit IV Fiber Optics | 4a. Compare wired Communication with fiber optic communication for the given parameters. 4b. Compare the given | 4.1 Introduction to Fiber optic communication. 4.2 Strength and limitations of fiber optic system 4.3 Light propagation : reflection. |



| Unit | Unit Outcomes (UOs) (in cognitive domain) | Topics and Sub-topics |
|--|---|--|
| | characteristics of reflection and refraction in fiber optics. 4c. Identify the different light sources for the given application with justification. 4d. Explain with sketch the working principle of the given light sources and detectors used in fiber optics. | refraction, snell's law 4.4 Light propagation through cable: Mode of propagation, index profile 4.5 Fiber optic cables: cable construction, fiber optics cable modes, single mode, step index fiber, multimode index fiber, multimode graded index fiber, fiber cable losses. 4.6 Light source and Detector: Light emitting diode (LED), Photo Transistor, Laser diode, optocoupler. |
| Unit– V Data Communica tion Protocols and Interfacing Standards | 5a. Explain with sketch the given functional block of Open Systems Interconnection model/ TCP/IP protocol. 5b. Describe with sketch the function of the given protocol with block diagram. 5c. Identify network topologies for the given application with justification. 5d. Explain with sketch the given networking devices. | 5.1 OSI(Open Systems Interconnection) Reference model 5.2 RS-232 and RS-485 Interface: Introduction, and working principle 5.3 LAN standards. 5.4 Introduction to IEEE Standards for LAN . 5.5 Network topologies, introduction star, ring, tree, bus, mesh, hybrid 5.6 Introduction to protocol, FTP, SMTP, TCP/IP, UDP 5.7 Basic functions of networking devices: modem, switches, routers, repeaters, hubs, bridges, gateway. |
| Unit– VI Advanced Data Communica tion | 6a. Compare the given conventional technology with the given type of wireless technology. 6b. Classify wireless media for the given application with justification. 6c. Explain with block diagram the given data communication wireless technology. 6d. Compare the given parameters of blue tooth and USB architecture. | 6.1 Introduction to Wi-Fi and Wi- Max 6.2 Bluetooth architecture and its layers, 6.3 Universal Serial Bus (USB) architecture. 6.4 Bluetooth and USB comparison. |

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

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|--------------|--|----------------|------------------------------|-----------|-----------|-------------|
| | | | R Level | U Level | A Level | Total Marks |
| I | Data communication and modulation | 8 | 2 | 4 | 6 | 12 |
| II | Digital modulation techniques | 8 | 2 | 4 | 6 | 12 |
| III | Data communication media | 8 | 4 | 4 | 4 | 12 |
| IV | Fiber optics | 8 | 2 | 4 | 6 | 12 |
| V | Data communication protocols and interfacing standards | 10 | 2 | 4 | 8 | 14 |
| VI | Advance data communication | 6 | 2 | 2 | 4 | 08 |
| Total | | 48 | 14 | 22 | 34 | 70 |

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

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:

- Prepare journals based on practical performed in laboratory.
- Give seminar on any relevant topic using PowerPoint presentation.
- Undertake micro-projects.
- Compare different types of transmission media
- Undertake a market survey of different types of data communication cables.
- Configure TCP/IP.
- Configure Wi-Fi, Bluetooth

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:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- '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.
- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide student(s) in undertaking micro-projects.
- Guide students for using TCP-IP PROTOCOLS.



- g. Use PPTs to explain the construction and working of fiber optic cables.
- h. Use PPTs to explain the construction and working of GPIB.

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-projects 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.

Suggestive lists of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

- a. Establish half duplex communication using RS-232.
- b. Generate PAM, PWM, PCM&PPM by using appropriate Integrated Circuit.
- c. Configure LAN for computer laboratory having 10 computers using suitable network topology.
- d. Prepare charts/Flex for various network topologies.
- e. Develop fibre optics based links for data communication.
- f. Prepare comparative analysis of network devices.
- g. Establish data communication using Wi-Fi.
- h. Prepare comparison report on various types of data communication cables available in market.

13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|--------|---|---|---|
| 1 | Electronic Communication System | Wayne Tomasi | Prentice Hall of India, 5th Edition ISBN 13:9780130494924 |
| 2 | Practical Industrial Data Communications. | Reynders D., Steve Macky, Wright Edwin | Newnes publication, 2005, ISBN 10:07506639523 |
| 3 | Electronic Communication System | George F. Kennedy, Barnard Davis | Tata McGraw Hill, 4 th edition, ISBN 13:9780074636824 |
| 4 | Data Communication & Networking | Forouzan B.A. | McGraw Hill Education; 5 edition (1 September 2012) ISBN-13: 978-0073376226 |
| 5 | Principles of Digital communication systems and computer networks | Prasad K.V.K.K. | Dreamtechpress, New Delhi, 2013, ISBN 13:9788177223620 |
| 6 | Computer Networks | Tanenbaum, Andrew S. David J. Wetherall | Pearson; 5 edition (27 September 2010) ISBN 13:9788121924252 |
| 7 | Text Book of | Kumar A. | Umesh Publication |

| S. No. | Title of Book | Author | Publication |
|--------|---|--------------------------------|--|
| | Communication Engg. | | ISBN 13:978818114160 |
| 8 | Communication Networking | A. Kumar,D. Manjunath,Joy Kuri | Academic Press Publication 2004 ISBN 13:9780124287518 |
| 9 | Electronic Communication & Data Communication | Hemant Kumar Gurg, SoniManish | University Book House Private Ltd. ISBN 13:9788181980717 |
| 10 | Optical Fiber Systems: Technology, Design, and Applications | Kao, Charles K. | Published by McGraw-Hill Inc.,US (1982) ISBN 13: 9780070332775. |
| 11 | Fiber Optic Communication System | Agrawal, Govind P. | Wiley; 4 edition (October 19, 2010) ISBN 13: 9780470505113 |
| 12 | Optical communications essentials | Keiser, Gerd | McGraw- Hill, New Delhi-2003 ISBN13:9780071412049 |

14. SOFTWARE/LEARNING WEBSITES

- a. www.youtube.com/watch?v=nV_AtmUS7IE
- b. en.wikipedia.org/wiki/IEEE_802
- c. searchmobilecomputing.techtarget.com/definition/IEEE-802-Wireless-Standards-Fast-Reference
- d. network-communications.blogspot.in/2011/06/802-standards-ieee-8022-8023-8025-80211.html
- e. www.youtube.com/watch?v=_9s_7RaopVg
- f. www.youtube.com/watch?v=F35sSPTahS8
- g. www.tutorialspoint.com/data_communication_computer_network/computer_network_topologies.htm
- h. www.e-tutes.com/
- i. www.youtube.com/watch?v=MrJswUU143M
- j. www.youtube.com/watch?v=SUKluEa7KhU
- k. www.youtube.com/watch?v=vHz6gGmLxzQ
- l. www.youtube.com/watch?v=C-N_vN_tmA0&spfreload=10



