# PEOPLE'S UNIVERSITY, BHOPAL

Programme: **B. Tech. (Electronics and Communication Engineering)**          Semester: **VI**

| Subject Title | Subject Code | Credit | | | Theory | | |
|---|---|---|---|---|---|---|---|
| | | **L** | **T** | **P** | **External (70)** | **Internal (30)** | **Total (100)** |
| **Cellular Mobile Communication** | **ECT -601** | 3 | 1 | - | | | Min: 40 (D Grade) |

**Duration of theory (External): 3 hours**
**Theory internal - max marks: 30**
> Best of two mid semester test                                           – Max. Marks: 20
> Assignment / Quiz/ Regularity                                          – Max. Marks: 10

| Unit | Contents (Theory) |
|---|---|
| **I** | Introduction to cellular mobile system and concepts of GSM, a basic cellular system, performance criteria, Uniqueness of mobile radio environment, Operation of cellular systems, Planning of cellular system. Elements of Cellular Radio System Design: General description of problem, Concept of frequency reuse, channels, Co channel interference, reduction factor, Hand off mechanisms, Cell splitting, Consideration of the components of cellular systems. |
| **II** | Co-channel Interference, real time co-channel interference measurement at mobile radio transceivers, Design of antenna system - Omni directional and directional, Lowering the antenna height, Reduction of co-channel interference, Umbrella- Pattern effect, Diversity receiver, Designing a system to serve a predefined area that experiences Co-Channel Interference. Types of Non co-channel interference- adjacent channel Interference, Near-End-Far-End interference, Effects on Near-End mobile units, Cross-Talk, Effects on coverage and interference by applying power decrease, antenna height decrease, Beam Tilting, Effects of cell site Components, Interference between systems, UHF TV Interference, long distance interference. |
| **II** | Cell coverage for signal and traffic : General introduction, Obtaining the mobile point-to-point model, Propagation over water or flat open area, foliage loss, propagation in near in distance, long distance propagation, point-to-point prediction model, Cell site antenna heights and signal coverage cells, Mobile-to-mobile propagation. Cell site antennas and mobile antennas: Equivalent circuits of antennas, Gain and Pattern Relationship, Sum and Difference patterns, Antennas at cell site, mobile antennas. |
| **IV** | Frequency management and Channel Assignment: Frequency management, Frequency spectrum utilization, Setup channels, Fixed channels assignment, Non-fixed channel assignment algorithms, Traffic and channel assignment. Handoffs and Dropped Calls: Types of Handoff, Initiation of Handoff, Delaying a Handoff, Forced Handoff, Queuing of Handoff, Power- Difference Handoff, Mobile Assisted Handoff and Soft Handoff, Cell-site Handoff and Intersystem Handoff, Dropped Call Rate. |
| **V** | Digital Cellular System: GSM, Architecture (working aspects of BTS & MSC), Layer Modeling, Transmission, GSM channels and Channel Modes, Multiple Access Scheme: CDMA, Terms of CDMA systems, output power limits and control, Modulation characteristics, Call processing, Hand off procedures. Miscellaneous Mobile Systems: TDD Systems, Cordless Phone, PDC, PCN, PCS, Non Cellular Systems, Mobile Integrated Radio Systems, Mobile Satellite Communication. |

**References:**

**1**    Lee: Cellular and Mobile Communication
**2**    D. P. Agrawal and Q. An Zeng: Wireless and Mobile Systems
**3**    Faher Kamilo: Wireless Digital Communication
**4**    G. J. Mullet: Introduction to Wireless Telecommunication Systems and Networks
**5**     Zeimer & Tranter: Principles of Communications

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Programme: **B. Tech. (Electronics and Communication Engineering)**          Semester: **VI**

| Subject Title | Subject Code | Credits | | | Theory | | | Practical | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **L** | **T** | **P** | **External (70)** | **Internal (30)** | **Total (100)** | **External (35)** | **Internal (15)** | **Total (50)** |
| **Industrial Electronics** | **ECT- 602** | 3 | 1 | 2 | | | Min: 40 (D Grade) | | | Min: 20 (D Grade) |

**Duration of Theory (Externals): 3 Hours**
**Theory Internal - Max Marks: 30**
        Best of Two Mid Semester Test                           –Max Marks:    20
        Quiz/Assignment / Attendance                       – Max. Marks:   10
**Practical Internal - Max Marks: 15**
        Lab Performance, Lab Record & Viva               –Max Marks:    10
        Assignment / Quiz                               – Max. Marks:   05

| Unit | Contents (Theory) |
|---|---|
| **I** | **Rectifiers:** Uncontrolled, Half-Controlled and Fully Controlled Single-Phase and Three-Phase Rectifiers for Resistive and Resistive-Inductive Load, Use of Free-Wheel Diode, Dual Converter, Input and Output Performance Parameters, Heat Sink. |
| **II** | **AC Voltage Regulators and Cyclo-converters:** Principle of On-Off Control and Phase Control, Single-Phase Voltage Controller for Resistive and Resistive-Inductive Load, Sequence Control of AC Voltage Controller, Three-Phase Voltage Regulator. Principle of Cyclo-converter, Single-Phase to Single-Phase Step-up and Step-Down Cyclo-Converter, Three-Phase to Single-Phase and Three-Phase to Three-Phase Cyclo-Converter. |
| **III** | **Inverters:** Single-Phase Bridge Inverter, Three-Phase Inverters-180o and 120o Conduction Mode, Voltage Control of Single-Phase Inverters-Single, Multiple, Sinusoidal, Modified Sinusoidal Pulse-Width Modulation, Advanced Modulation Techniques- Trapezoidal, Staircase, Stepped, Harmonic Injection and Delta Modulation. Induction Motor AC Drives. |
| **IV** | **Chopper:** Principle of Step-Down and Step-Up Chopper, Converter Classification, Multi-Phase Chopper, Switching-Mode Regulators-Buck, Boost, Buck-Boost and Cuk Regulators, DC Drives. |
| **V** | **Residential and Industrial Application:** Space Heating and Air Conditioner, High Frequency Fluorescent Lighting, Electronic Timer, Battery Charger, Switch-Mode-Power- Supply (SMPS), Uninterruptible Power Supply (UPS), Static Switches, Induction Heating, Electric Welding, Introduction of HVDC and FACTs. |

**References:**

1     Mohan, Undeland and Robbins: Power Electronics, Wiley-India Edition.

2     M. H. Rashid: Power Electronics- Circuits, Devices and Applications, Pearson Education.

3     P. S. Bimbhra: Power Electronics, Khanna Publisher.

4     Alok Jain: Power Electronics and Its Application, Penram International.

5     Biswanath Paul: Industrial Electronics, PHI Learning.

6     T. E. Kissell : Industrial Electronics, PHI Learning.

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| Subject Title | Subject Code | Credits | | | Theory | | | Practical | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Digital Signal Processing** | **ECT-603** | **L** | **T** | **P** | **External (70)** | **Internal (30)** | **Total (100)** | **External (35)** | **Internal (15)** | **Total (50)** |
| | | 3 | 1 | 2 | | | Min: 40 (D Grade) | | | Min: 20 (D Grade) |

**Duration of Theory (Externals): 3 Hours**
**Theory Internal - Max Marks: 30**

    Best of Two Mid Semester Test              –Max Marks:  20
    Quiz/Assignment / Attendance              – Max. Marks: 10

**Practical Internal - Max Marks: 15**

    Lab Performance, Lab Record & Viva         –Max Marks:   10
    Assignment / Quiz                      – Max. Marks:  05

| Unit | Contents (Theory) |
|---|---|
| **I** | **Discrete-Time Signals and Systems:** Discrete-Time Signals, Discrete-Time Systems, Analysis of Discrete-Time Linear Time-Invariant Systems, Discrete Time systems described by Difference Equation, Implementation of Discrete-Time Systems, Signal flow Graph representation of digital network, matrix representation. |
| **II** | **Laplace Transform:** Laplace Transform and its inverse: Definition, existence conditions, Region of Convergence and properties, Application of Laplace transform for the analysis of continuous time LTI system (stability etc.) Significance of poles & zeros. <br> **The z-Transform:** The Direct z-transform, Properties of the z-transform, Rational z-transforms, Inversion of the z-transform, analysis of Linear Time-Invariant systems in the z- domain. |
| **III** | **Frequency Analysis of Discrete Time Signals:** Discrete Fourier series (DFS), Properties of the DFS, Discrete Fourier Transform (DFT), Properties of DFT, Two dimensional DFT, Circular Convolution. |
| **IV** | **Efficient Computation of the DFT:** FFT algorithms, decimation in time algorithm, Decimation in frequency algorithm, Decomposition for 'N' composite number. <br> **DSP Processors:** Brief Introduction of Advanced DSP Processors (e.g. TMS320). |
| **V** | **Digital filters Design Techniques**: Design of IIR and FIR digital filters, Impulse invariant and bilinear transformation, windowing techniques- rectangular and other windows, Examples of FIR filters, design using Windowing. |

**References:**

1  A.V. Oppenheim and R. W. Schafer: Digital Signal Processing, Prentice Hall.
2  Ingle VK and Proakis John G : Digital Signal Processing A MATLab based Approach, Cengage Learning.
3  John. G. Proakis and Monolakis: Digital Signal Processing, Pearson Education.
4  Salivahanan and Vallavraj: Digital Signal Processing, Mc Graw Hill.
5  S. K. Mitra: Digital Signal Processing- A Computer based Approach, Mc Graw Hill.
6  Schilling and Harris: Fundamentals of DSP using MATLAB, Cengage Learning.

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## List of Experiments

  **1**   To Plot Pole Zero from transfer function.

  **2**    Study of Circular Convolution.

  **3**   Study of Sampling Theorem in Time domain.

  **4**   To find the frequency contents of the speech signal using FFT

  **5**   To design IIR filter using impulse invariant method.

  **6**   To apply FIR LPF to filter the known signal.

  **7**   To design analog filter (low pass, high pass )

  **8**   To design IIR filter using bilinear transformation.

  **9**   To develop a program for computing discrete Fourier transforms.

  **10**   To develop a program for realization of IIR  digital filter (Direct,cascade,palallel)

## Procedure for performing the Experiments

All experiments (wherever applicable) should be performed and simulated using Simulation S/W (MATLAB/Sci-LAB).

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| Subject Title | Subject Code | Credits | | | Theory | | | Practical | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Microwave Engineering** | **ECT-604** | **L** | **T** | **P** | **External (70)** | **Internal (30)** | **Total (100)** | **External (35)** | **Internal (15)** | **Total (50)** |
| | | 3 | 1 | 2 | | | Min: 40 (D Grade) | | | Min: 20 (D Grade) |

**Duration of Theory (Externals): 3 Hours**
**Theory Internal - Max Marks: 30**
          Best of Two Mid Semester Test                              –Max Marks:  20
          Quiz/Assignment / Attendance                         – Max. Marks: 10
**Practical Internal - Max Marks: 15**
          Lab Performance, Lab Record & Viva                 –Max Marks:    10
          Assignment / Quiz                                          – Max. Marks:  05

| Unit | Contents (Theory) |
|---|---|
| **I** | **Microwave Transmission System:** General representation of E M field in terms of TEM, TE and TM components, Uniform guide structures, rectangular wave guides, Circular Wave guides, Solution in terms of various modes, Properties of propagating and evanescent modes, Dominant modes, Normalized model voltages and currents, Power flow and energy storage in modes frequency range of operation for single mode working, effect of higher order modes, Strip line and micro strip lines general properties, Comparison of coaxial, Micro strip and rectangular wave guides in terms of band width, power handling capacity, economical consideration etc. |
| **II** | **Microwave Networks and Component:** Transmission line ports of microwave network, Scattering matrix, Properties of scattering matrix of reciprocal, nonreciprocal, loss less, Passive networks, Examples of two, three and four port networks, wave guide components like attenuator, Phase shifters and couplers, Flanges, Bends, Irises, Posts, Loads, Principle of operation and properties of E-plane, H-plane Tee junctions of wave guides, Hybrid T, Multi-hole directional coupler, Directional couplers, Microwave resonators- rectangular. Excitation of wave guide and resonators by couplers. Principles of operation of nonreciprocal devices, properties of ferrites, Isolators and phase shifters. |
| **III** | **Microwave Solid State Devices and Application:** PIN diodes, Properties and applications, Microwave detector diodes, detection characteristics, Varactor diodes, parametric amplifier fundamentals, Manley-Rowe power relation MASER, LASER , Amplifiers, Frequency converters and harmonic generators using Varactor diodes, Transferred electron devices, Gunn effect, Various modes of operation of Gunn oscillator, IMPATT, TRAPATT and BARITT. |
| **IV** | **Microwave Vacuum Tube Devices:** Interaction of electron beam with electromagnetic field, power transfer condition. Principles of working of two cavity and Reflex Klystrons, arrival time curve and oscillation conditions in reflex klystrons, mode-frequency characteristics. Effect of repeller voltage variation on power and frequency of output. Principle of working of magnetrons. Electron dynamics in planar and cylindrical magnetrons, Cutoff magnetic field, Resonant cavities in magnetron, Π-mode operation Mode separation techniques, Rising sun cavity and strapping. Principle of working of TWT amplifier. Slow wave structures, Approximate gain relationship in forward wave TWT. |
| **V** | **Microwave Measurements:** Square law detection, Broadband and tuned detectors. Wave-guide probes, Probe and detector mounts, Slotted line arrangement and VSWR meter, Measurement of wave-guide impedance at load port by slotted line, Microwave bench components and source modulation. Measurement of scattering matrix parameters, High, Medium and low-level power measurement techniques, Characteristics of bolometers, bolometer mounts, Power measurement bridges, Microwave frequency measurement techniques, calibrated resonators (transmission and absorption type). Network Analyzer and its use in measurements. |

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**References:**

**1**    Y. S. Liao: Microwave Devices, PHI.

**2**    R. E. Collins: Foundations of Microwave Engineering, 2nd Edition, Wiley Publications.

**3**    J.H. Reich: Microwave Principles, East West Press.

**4**    D. M. Pozar: Microwave Engineering, 3rd Edition, Wiley Publications.

**List of Experiments**

**1**    To Study the Magic Tee.

**2**    To Study the Isolator.

**3**    To Study the Circulator.

**4**    To determine the standing wave ratio and reflection coefficient.

**5**    To Study the attenuators.

**6**    To study the function of multihole directional coupler.

**7**    To Study the characteristics of Gunn diode.

**8**    To Study the characteristics of reflex klystron tube and to determine its electronic tuning range.

**9**    To determine the frequency and wavelength in a rectangular waveguide working on TE10 mode.

**10**    To Measure the unknown impedance with smith chart.

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| Subject Title | Subject Code | Credits | | | Theory | | | Practical | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Data Communication & Networks** | **ECT- 605** | **L** | **T** | **P** | **External (70)** | **Internal (30)** | **Total (100)** | **External (35)** | **Internal (15)** | **Total (50)** |
| | | 3 | 1 | 2 | | | Min: 40 (D Grade) | | | Min: 20 (D Grade) |

**Duration of Theory (Externals): 3 Hours**
**Theory Internal - Max Marks: 30**
        Best of Two Mid Semester Test               –Max Marks:   20
        Quiz/Assignment / Attendance           – Max. Marks:   10
**Practical Internal - Max Marks: 15**
        Lab Performance, Lab Record & Viva       –Max Marks:   10
        Assignment / Quiz                    – Max. Marks:   05

| Unit | Contents (Theory) |
|---|---|
| **I** | **Introduction to Data Communication and Networks**: Data Communication, Networks – Physical structures; different topologies, Categories of Networks: LAN, MAN, WAN, Interconnection of networks, The Internet, Protocols and Standards, Standards Organizations. Network Models, Layered tasks, The OSI model, different layers in OSI model. TCP/IP protocol suite; different layers, addressing, - physical, logical, port and specific addresses, Analog and digital, digital signals-Bit Length, Digital Signal as a Composite Analog Signal, Transmission of Digital Signals, Data Rate Limits-Noiseless Channel, Noisy Channel. |
| **II** | **Physical Layer**: Digital-to-Digital Conversion-Line Coding, Line Coding Scheme, Block Coding, Scrembling. Multiplexing – Frequency Division, Wavelength Division, Synchronous Time Division, Statistical Time Division Multiplexing. Circuit-Switched Networks – Three Phases, Efficiency, Delay. Datagram Networks - Routing Table, Efficiency, Delay, Datagram Networks in the Internet. Virtual Circuit Networks - Addressing, Three Phases, Efficiency, Delay, Circuit Switched Technology in WANs. Structure of Circuit and Packet switches, Dial-up Modems, Modem Interfacing, Digital Subscriber Line - ADSL, ADSL Lite, HDSL, SDSL, VDSL, Cable TV for Data Transfer- Bandwidth, Sharing, CM and CMTS, Data Transmission Schemes. |
| **III** | **Data Link Layer**: Introduction - Types of Errors, Redundancy, Detection Vs Correction, Forward Error Correction Vs Retransmission, Modular Arithmetic. Block Coding - Error Detection, Error Correction, Hamming Distance, Minimum Hamming Distance. Linear Block Codes, Cyclic Codes - Cyclic Redundancy Check, Hardware Implementation, Polynomials, Cyclic Code Analysis, Advantages. Checksum, Framing - Fixed and Variable-Size. Flow and Error Control, Protocols, Noiseless Channels – Simplest and Stop-and-Wait Protocols. Noisy Channels - Stop-and-Wait Automatic Repeat Request, Go-Back-N Automatic Repeat Request, Selective Repeat Automatic Repeat Request. |
| **IV** | **Medium Access**: Random Access- ALOHA, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). Controlled Access-Reservation, Polling, Token Passing. Channelization- Frequency-Division Multiple Access (FDMA), Time- Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA). IEEE Standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet, IEEE 802.11- Architecture, MAC Sub layer, Addressing Mechanism, Physical Layer. Bluetooth- Architecture, Radio Layer, Baseband Layer, L2CAP. |
| **V** | **Connecting LANs**: Connecting Devices- Passive Hubs, Repeaters, Active Hubs, Bridges, Two-Layer Switches, Three-Layer Switches, Gateway. Backbone Networks-Bus, Star, Connecting Remote LANs. Virtual LANs - Membership, Configuration, Communication between Switches, Network layer – logical addressing - .IPv4Addresses- Address Space, Notation, Classful Addressing, Classless Addressing, Network Address Translation (NAT). IPv6 Addresses - Structure and Address Space. Internetworking - Need for Network Layer, Internet as a Datagram Network, Internet as a Connectionless Network. IPv4- Datagram, Fragmentation, Checksum, Options. IPv6 - Advantages, Packet Format, Extension Headers. Transition from IPv4 to IPv6. |

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**References:**

1   B. A. Forouzan and Sophia Chung Fegan: Data Communications and Networking
2   W. Tomasi: Introduction to Data Communications and Networking
3   A. S. Tanenbaum: Computer Networks
4   W. Stalling: Data and Computer Communication
5   P. C. Gupta: Data Communications and Computer Networks
6   A. Elahi and M. Elahi: Data Network and Internet-Communications Technology
7   Duck: Data Communication and Networking

## List of Experiments

1   To Study different Types of Transmission Media.
2   To Study Serial Interface RS-232.
3   To Study Parallel PC-to-PC Communication.
4   To Study Serial PC-to-PC Communication.
5   To Study LAN using various topology.
6   To Study Configure MODEM of Computer.
7   To Study Fiber Optic Communication.
8   To Study Wireless Communication.
9   To Study PC-PC Communication using LAN.
10  To Study PC-PC Communication using WLAN.

## Procedure for performing the Experiments

All experiments (wherever applicable) should be performed and simulated using Data Communication Trainer Kit, and the Transmission Media Test Kit.

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| Subject Title | Subject Code | Credits | | | Practical | | |
|---|---|---|---|---|---|---|---|
| **Professional Skills –III** | **BT- 606** | **L** | **T** | **P** | **External** **(Nil)** | **Internal** **(50)** | **Total (50)** |
| | | 0 | 0 | 2 | | | Min: 20 (D Grade) |

**Practical Internal - Max Marks: 50**

Lab Performance, Lab Record & Viva          –Max Marks:    45
Assignment / Quiz          – Max. Marks:   05

| Contents (Practical) |
|---|
| **Group discussion** <br><br> Introduction to group discussion, structure and dynamics; Techniques of effective participation in group discussion; Preparing for group discussion; Ways to carry out group discussion, <br><br> Parameters— Contact, body language, analytical and logical thinking, decision making <br><br> **Interview Technique** <br><br> Necessity, How to prepare for interviews; Language and style to be used in interview; Types of interview questions and how to answer them; Tips for handling common questions. <br><br> |

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| Subject Title | Subject Code | Credits | | | Practical | | |
|---|---|---|---|---|---|---|---|
| **Research Methodology** | **ECT- 607** | **L** | **T** | **P** | **External (Nil)** | **Internal (50)** | **Total (50)** |
| | | 0 | 0 | 2 | | | Min: 20 (D Grade) |

**Practical Internal - Max Marks: 50**

Lab Performance, Lab Record & Viva          –Max Marks:   45
Assignment / Quiz          – Max. Marks:  05

| Unit | Contents *(Practical)* |
|---|---|
| **I** | **Objectives and types of research:** Motivation and objectives – Research methods *vs* Methodology. Types of research – Descriptive *vs*. Analytical, Applied *vs*. Fundamental, Quantitative *vs*. Qualitative, Conceptual *vs*. Empirical. |
| **II** | **Research Formulation** – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem. |
| **III** | **Research design and methods** – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts. Developing a research plan - Exploration, Description, Diagnosis, and Experimentation. |
| **IV** | **Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation. |
| **V** | **Reporting and thesis writing** – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes. |

**References:**

1    Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.
2    Kothari, C.R., 1990. *Research Methodology: Methods and Techniques*. New Age International. 418p.
3    Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, Ess Ess Publications. 2 volumes.
4    Trochim, W.M.K., 2005. *Research Methods: the concise knowledge base*, Atomic Dog Publishing. 270p.
5    Wadehra, B.L. 2000. *Law relating to patents, trade marks, copyright designs and geographical indications*. Universal Law Publishing.

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| Subject Title | Subject Code | Credits | | | Practical | | |
|---|---|---|---|---|---|---|---|
| | | **L** | **T** | **P** | **External** | **Internal** | **Total (50)** |
| **SQL** | **BT-628** | - | - | 2 | **(35)** | **(15)** | Min: 20 (D Grade) |

**Practical Internal - Max Marks: 15**

         Lab Performance, Lab Record & Viva       –Max Marks:    10

         Assignment / Quiz                      – Max. Marks:   05

| Unit | Contents *(Practical)* |
|---|---|
| **I** | **Introduction to databases:** Database and its Hierarchies, History of Databases, Types of DBMS, Data Environment –Database and DBMS software, Database Architecture, Three layered Architectural /O Functions, Characteristics of database approach. Relational Model – Logic Data models, Relational Data Model, Querying Relational Data Model, Relational Algebra, and Relational Calculus. |
| **II** | **SQL:** SQL Language, SQL Database object, SQL Data Types, DDL, DML, and DCL commands, Deleting data, Retrieving Data, Insertion of Data, Updating Data , Integrity constraint ,Keys, Creating and altering tables ,Views, Sequence, Index. Concept of domain, tuple, Structure query), SQL operator and Clauses :-  Logical, relational, in, between, like operator, Order by , group by, Having clause, SQL Function :-> Numeric (ABS, POWER, SQRT), Conversion ( to_number, to_char), Aggregate( SUM, MAX, MIN, COUNT, AVG) |
| **III** | **SQL operator and Clauses :** Logical, relational, in, between, like operator, Order by , group by, Having clause, SQL Function :-> Numeric (ABS, POWER, SQRT), Conversion ( to_number, to_char), Aggregate( SUM, MAX, MIN, COUNT, AVG) |
| **IV** | **Stored Procedures:** Benefits of Stored Procedures Types of Stored Procedures - System Stored Procedures, User-Defined Stored Procedures Creating and Altering Stored Procedure Indexing:- Creating an Index, Optimizing the Index Performance, Removing the Index. |
| **V** | Introduction, Triggers Vs constraints, DML Triggers, DDL Triggers, ERROR. |

**Reference:**

1. Simple Steps in SQL Server 2008.
2. SQL Server 2008, The complete Reference, TMH.
3. SQL Server 2008 Black book, BPB Publishers.