**Scheme of Teaching and Examination for**

**5 th Semester of 3 Years Diploma in Electrical Engineering**

Duration of Semester : **14 Weeks**
Student Contact Hours : **36 Hrs**
Total Marks : **800**
Effective from : 2017 -18 Session

| Sl. No. | Name of Subject | Subject Code | Subject | Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Hours of Exam | Full Marks of Subject | Final Exam / committee marks | Internal Assessment | Pass Marks Final / Ext. Exam | Pass Marks in Subjects |
| 1. | Power System II | ELE 503 | Theory | 3 | - | - | 3 | 100 | 80 | 20 | 26 | 40 |
| 2. | Electrical Machines II | ELE 504 | Theory | 3 | - | - | 3 | 100 | 80 | 20 | 26 | 40 |
| 3. | Traction | ELE 505 | Theory | 3 | - | - | 3 | 100 | 80 | 20 | 26 | 40 |
| 4. | Elective I | ELE 506/CSE503/ECE505 | Theory | 3 | - | - | 3 | 100 | 80 | 20 | 26 | 40 |
| 5. | Elective II | ELE 507/ECE406/ECE503/ELE508 | Theory | 3 | - | - | 3 | 100 | 80 | 20 | 26 | 40 |
| 6. | Electrical Machines II Lab | ELE 509 | Practical | - | - | 2 | 4 | 50 | 40 | 10 | - | 20 |
| 7. | Power System Lab | ELE 510 | Practical | - | - | 2 | 4 | 50 | 40 | 10 | - | 20 |
| 8. | Elective I lab | ELE 511/ELE 512/ELE 513 | Sessional | | | 2 | - | 50 | 30 | 20 | - | 25 |
| 9 | Elective II Lab | ELE 514/ECE409/ECE512/ELE515 | Sessional | - | - | 2 | - | 50 | 30 | 20 | - | 25 |
| 10. | In Plant Training | 502 | sessional | - | - | - | - | 50 | 30 | 20 | - | 25 |
| 11. | DLS | 501 | Sessional | - | - | 4 | - | 50 | 30 | 20 | - | 25 |
| | **Total Hours of Teaching per week :** | | | **15** | | **12** | | | | | | |

Elective I (Illumination Engineering- ELE 506/ Micro. Processor & Micro. Controller- CSE503/ Programmable Logic Controller - ECE 505)
Elective II (Maintenance of Electrical Machines ELE507/Control System ECE406/Instrumentation ECE503/ Robotics & Smart System ELE508)
Total Marks : Theory : Practical : Sessional :
L : Lecture, T : Tutorial P : Practical

Note:
1. Period of Class hours should be of 1 hrs duration as per AICTE norms.
2. Remaining Hrs every week has been marked for students for Library and Student Centered Activities.
3. Drawing / Graphics / Practical / Sessional examinations will be held at parent institution.
4. Board will depute examiner for Practical examination.
5. Regarding sessional examination the parent institution will form a three member committee and this committee will examine the sessional records and hold viva of the examinee for 60 % marks allotted to the subject. Marks for remaining 40 % will be provided by the Faculty concerned on the basis of evaluation of each job / work throughout the semester.
6. Inplant Training of 04 weeks duration to be undertaken after 4th semester Exam and before start of 5th semester classes.

Subject : Power System -II
Subject Code : ELE503
Total Hours : 42
Full Marks : 80 + 20 = 100

Content:

1. Transients in Power System and protection against them. Elements of Power System dynamics, Computer methods in Power System Analyses, load Flow Studies. 06 Hrs

2. Power transmission systems – Electrical characteristics of overhead lines and cables, Sag & Tension, Proximity, Corona, Skin effect, Bundled conductors, Transposition of conductors, Per unit representation of system quantities. Steady state performance of transmission network – ABCD parameters of short, medium and long lines. 12 Hrs

3. Methods of active and reactive power control – use of VAR compensators Elements of economic operations. Electricity tariffs. Distribution systems – feeders and distributors radial and mesh system – distribution sub-station – earthing, Important I.E. rules Indian Electricity Acts. 07 Hrs

4. Nature of faults in electrical systems, fault calculations, symmetric and asymmetric faults – method of sequence components – sequence networks. 05 Hrs

5. Study of Protective Devices- Isolators, disconnecting switch, lightening arrester, Horn gap, CT, PT, Protective relays and their applications to power apparatus and systems. Principles of circuit breakers – different types, oil circuit breakers, air circuit breakers, vacuum circuit breakers, $SF_6$ – circuit breakers, their uses and comparison. 12 Hrs

BOOKS :

1. Stevenson W.D. : Elements of Power System Analysis; McGraw Hill International Edn.

2. Grainger J J & Stevenson W.D. Power System Analysis ; McGraw Hill Intl. Edn.

3. Nagrah I J & Kothari D.P. : Power System Engg. TMH Pub. Co. Ltd.

4. Saadat: Power System Analysis, TMH

5. Pabla A.S. : Electric Power Distributors System TMH Pub.

6. K.C.Pal: Heat Power, Orient Longman

7. Wadhwa: Electrical Power Systems, New Age International

8. Wadhwa: High Voltage Engineering, New Age International

9. Protection & Switch gear – S.S. Rao

Subject: Power System -Lab
Subject Code ELE510 Full marks 50

**List of Experiments**

1. Determination of Transient response of I st and II nd order systems
2. Experiment on circuit protection
3. Experiment on Power System dynamics
4. Study of different types of load Flows
5. Determination of losses in cables,
6. Determination of Sag & Tension in experimental setup
7. Study of Corona and Skin effects in transmission lines
8. Study of Steady state performance of transmission network
9. Determination of active and reactive power and study of control using VAR compensators.
10. Study of feeders and distributors
11. Measurement of earth resistance and earthing for electrical establishment
12. Determination / diagnosis of faults in electrical systems and fault rectification.
13. Study of , symmetric and asymmetric faults
14. Study of Protective Devices- Isolators, disconnecting switch, lightening arrester
15. Study of different circuit breaker

(Note : Minimum 10 experiments from the above list has to performed by students)

Subject : Electrical Machine -II
Subject Code : ELE504
Total Hours : 42
Full Marks : 80 + 20 = 100

**Contents: Theory**

| Chapter | Name of the Topic | Hours |
|---|---|---|
| 01 | **Three phase induction motor**<br>1.1 Construction of three phase induction motor<br>1.2 Production of rotating magnetic field<br>1.3 Principle of working/operation<br>1.4 Concept of slip<br>1.5 Equation of rotor induced emf, current, frequency, reactance, and impedance under steady and running condition<br>1.6 Torque equation of three phase induction motor<br>1.7 Starting and running torque of squirrel cage and slip ring induction motor<br>1.8 Condition for maximum and starting torque<br>1.9 Torque slip characteristics of three phase induction motor<br>1.10 Effect of change in rotor circuit resistance on torque-slip characteristics<br>1.11 Effect of change in supply voltage on torque-slip characteristics | 08 |
| | 1.12 measurement of slip by<br>a) Tachometer method<br>b) Comparing rotor frequency and stator frequency<br>1.13 Speed control of three phase induction motor by<br>a) Pole changing method<br>b) Frequency control method<br>c) By stator voltage control<br>d) Rotor resistance control<br>1.14 Comparison between squirrel-cage and slip-ring induction motor.<br>1.15 Applications of three phase induction motor.<br>1.16 Power stages of three phase induction motor.<br>(Numerical on all above)<br>1.17 Double cage IM<br>a) Construction<br>b) Characteristic of outer, inner cage & combined characteristic<br>c) Industrial Applications<br>1.18 I.M. as a generalized transformer<br>1.19 Vector diagram of IM | 08 |
| | 1.20 Equivalent circuit of 3-phase IM (No numerical)<br>1.21 Starting of 3-phase IM (No numerical)<br>a) Stator resistance starter<br>b) Star-Delta starter<br>c) Auto transformer starter<br>d) Rotor resistance starter | 02 |
| 02 | **Three Phase Alternator**<br>2.1 Definition and construction of three phase Alternator<br>a) Armature<br>b) Rotor- smooth cylindrical & projecting type<br>2.2 Derivation of e.m.f. equation of Alternator which includes<br>a) Chording factor<br>b) Distribution factor | 04 |

| | | |
|---|---|---|
| | 2.3 Factors affecting the terminal voltage of Alternator<br>a) Armature resistive drop<br>b) Leakage reactance drop<br>c) Armature reaction at various power factors & concept of Synchronous impedance<br>2.4 Regulation of three phase Alternator by<br>a) Synchronous impedance method<br>b) mmf method | 04 |
| 03 | **Synchronous Motor**<br>3.1 Principle of working/operation<br>3.2 Synchronous Motor on load with constant excitation<br>3.3 Effect of excitation at constant load<br>3.4 V curve & inverted V curve<br>3.5 Hunting & phase swinging<br>3.6 Applications<br>3.7 Starting of Synchronous Motor<br>3.8 Comparison between IM & Synchronous Motor<br>(Numerical on all above ) | 06 |
| 04 | **Single phase Motors**<br>4.1 Double field revolving theory<br>4.2 Types of Single phase IM<br>4.3 Split phasing principle of starting<br>a) Resistance start induction run<br>b) Capacitor start induction run<br>c) Capacitor start Capacitor run<br>d) Double value Capacitor applications motor<br>4.4 Shaded pole IM<br>4.5 Applications | 06 |
| 05 | **Special machines**<br>5.1 Induction Generator: Principle of operation, Construction and Applications<br>5.2 Linear Induction Motor Principle of operation, Construction and Applications<br>5.3 AC series motor Principle of operation, Construction and Applications | 04 |
| | **Total** | **42** |

Subject : Electrical Machine -II Lab

Subject Code : ELE509

**Practical:**

Intellectual Skills: 1. Analytical Skills
2. Identification Skills

Motor Skills : 1. Measuring Skills
2. Connecting instruments

**List of Practical:**

1) a) To measure the slip of 3 phase IM by i) Tachometer
ii) Comparing rotor & stator frequency
iii) Stroboscopic method.

b) To reverse the direction of rotation of 3-phase IM.

2) To measure the performance of 3-phase IM by direct loading

3) To list different types of starters used for 3-phase IM .Identify & use the same to start & run 3-phase IM

4) Using an MG set (DC motor-Alternator) observe the effect of excitation & speed on induced e.m.f. & plot O.C.C. of the given alternator.

5) To find the percentage regulation of 3-phase alternator by synchronous impedance method at various power factors.

6) To find the percentage regulation of 3-phase alternator by direct loading Method at various power factors.

7) To list & explain various starting methods of synchronous motor & applying one of them to start the synchronous motor. Plot V & inverted V curve of the same.

8) To list the various types of 1-phase IM, Collect the literature for them from dealers/manufacturers of local places & compare on the following pts.
i) Method of starting ii) Cost iii) Performance iv) Starting torque etc. Prepare a report

**Books:**

| Sr.No. | Author | Title | Publisher |
|---|---|---|---|
| 01 | S. K. Bhattacharya | Electrical Machines | TTTI, Chandigarh |
| 02 | B. L. Theraja | Electrical Technology Vol. II | S Chand & Co. |
| 03 | C. L. Dawes | Electrical Technology | -- |
| 04 | P. S Bhimbra | Electrical Machines | |
| 05 | D.P. Khothari | Electrical Machines | |
| 06 | J. B. Gupta | Electrical Machines | |
| 07 | Ashfaq Hussain | Electrical Machines | |
| 08 | G. K Dubey | Electrical Drives | |
| 09 | A. Chakraborty | Electrical Machines | |
| 10 | M. G. Say | Electrical Machines & Design | |

Subject : Traction
Subject Code : ELE 505
Full Marks : 80+20=100
Hours : 42

Content-

| Chapter | Chapter Name & Content | Hours |
|---|---|---|
| 1 | **Traction Systems and Latest Trends**<br>**1.1** Explain the present scenario of Indian Railways – High speed traction, Metro<br>**1.2** Detail the latest trends in traction- Metro, monorail, Magnetic levitation Vehicle<br>**1.3** Explain types of traction systems and their significance – Steam, diesel, diesel-electric, Battery and electric traction systems<br>**1.4** Explain the general arrangement of different types of Electric traction systems and their significance – General arrangement of D.C.,A.C. single-phase, 3phase, Composite systems<br>**1.5**Choice of traction system – Diesel - Electric or Electric | **04** |
| 2 | **Mechanics of Train Movement**<br>**2.1** Draw the speed time curve related to different traction system-Analysis of speed time curves for main line, suburban and urban services<br>**2.2** Solve numerical based on speed time curve - Simplified speed time curves , Relationship between principal quantities in speed time curves<br>**2.3** Calculate specific energy consumption- Requirement of tractive effort<br>**2.4** State the factors affecting Specific energy consumption -Specific energy consumption and factors affecting it. | **07** |
| 3 | **Traction Motors and Their Control**<br>**3.1** State the desirable features of traction motors.<br>**3.2** Explain Significance of D.C. series motor over D.C. Shunt motor - Significance of D.C. series motor as traction motor<br>**3.3** Explain working of various A.C. motors as traction motors - A.C. Traction motors – single phase, Three phase, Linear Induction Motor<br>**3.4**Comparison between different traction motors<br>**3.5** Apply various control methods applied to traction motors - Series – parallel control, Open circuit, Shunt and bridge transition, Pulse Width Modulation control of induction motors<br>**3.6** Explain different types of electric braking system | **15** |
| 4 | **Electric Locomotives and Auxiliary Equipment**<br>**4.1** Classify electric locomotive -Important features of electric locomotives<br>**4.2** Describe the function of auxiliaries in traction system -Different types of locomotives<br>**4.3** Describe the different current collecting methods in locomotives-Current collecting equipment<br>**4.4** Explain different control and auxiliary equipment used in the locomotive<br>**4.5** Describe the power conversion and transmission systems - Power conversion and transmission systems<br>**4.6** Explain Coach wiring and lighting devices-Coach wiring and lighting devices | **12** |

| | | |
|---|---|---|
| **5** | **Feeding and Distribution System.**<br>**5.1** Explain the distribution & feeder system pertaining to traction-distributions and feeders<br>**5.2** Classify traction substations - Requirements and selection<br>**5.3** Describe different methods of feeding the traction sub- station - Method of feeding the traction sub-station | **04** |
| | **Total** | **42 hours** |

**Book :-**

| SI.NO. | Title Name | Author's Name | Publication |
|---|---|---|---|
| **1** | Modem Electric traction | H. Partab | DhanpatRai and Sons, New Delhi |
| **2** | Electric traction | J. Upadhyay<br>S.N. Mahendra | Allied Publishers Ltd., DhanpatRai and Sons, New Delhi |
| **3** | Electric traction | A.T. Dover | Mac Millan, DhanpatRai and Sons, New Delhi |
| **4** | Electric traction Hand Book | R.B. Brooks. | Sir Isaac Pitman and sons Ltd. London. |

Subject : Illumination Engineering
Subject Code : ELE506
Total Hours : 42
Full Marks : 80 + 20 = 100

**Contents: Theory**

| Chapter | Name of the Topic | Hours |
|---|---|---|
| 1 | **Fundamentals of Illumination**<br>1.1 Illumination Terminology<br>1.2 Laws of Illumination<br>1.3 Featuring of good Illumination scheme<br>1.4 Advantages of good Illumination scheme<br>1.5 Measurement of level of Illumination (simple illumination) | 06 |
| 2 | **Lamps & Lighting Accessories**<br>2.1 Types of lamps: ARC lamps, HPMV lamps, Sodium Lamps, CFL Lamps, Metal halides, LED lamps<br>2.2 Neon Sign Tubes.<br>2.3 Neon Lamps.<br>2.4 Halogen Lamps.<br>2.5 Construction, working principle, advantages, disadvantages & Application of incandescent & Flurocent<br>2.6 Lighting accessories. (All fittings, switches, enclosers )<br>2.7 Illumination Auditing | 08 |
| 3 | **Illumination Control & Control Circuits**<br>3.1 Purpose of lighting control<br>3.2 Dimmer & Dimmer Transformer & their types<br>3.3 Electronic Dimmer<br>3.4 Enhancing Lighting control.<br>3.5 Control circuits for lamps (refer) : ON/OFF control & Illumination control. | 06 |
| 4 | **Illumination for Interior Applications**<br>4.1 Standard for various situations of Interior Illumination<br>4.2 Design Techniques<br>4.3 Design considerations for Interior location of Residential, Commercial, Industrial premises<br>4.4 Design Illumination scheme for different Interior locations of Residential, Commercial, Industrial unit. | 08 |
| 5 | **Illumination for Outdoor Applications**<br>5.1 Factory Lighting<br>5.2 Street Lighting (Latest Technology)<br>5.3 Flood Lighting<br>5.4 Railway Lighting<br>5.5 Lighting for Advertisement/Hoardings<br>5.6 Sports Lighting | 08 |
| 6 | **Lighting for Special Applications**<br>6.1 Agriculture & Horticulture<br>6.2 Health Care Centers / Hospitals<br>6.3 Decorating Purposes<br>6.4 Stage Lighting<br>6.5 Aquariums & Shipyards<br>6.6 Special purpose lamps used in photography video films. | 06 |
| | **Total** | **42** |

Subject : Illumination Engineering Lab
Subject Code : ELE511

**Practical:**

Skill to be developed:

Intellectual

Skills**:**

1. Apply different Designing Skills.
2. Select proper

equipment. Motor Skills**:**

1. Measurement of Illumination.
2. Drawing skills.

**List of Practicals:**

1. To Measure Illumination by luxmeter.
2. Visit to nearby lamp manufacturing industry.
3. Prepare a report of different luminaries available in the market & collect the technical data

   (Visit local market / Use internet for data collection).
4. Study the different lighting accessories required for varies types of lamps.
5. Design an Illumination scheme for a garden of medium size.
6. Design an Illumination scheme for a conference room of medium size.
7. Design an Illumination scheme for a workshop for fine work of medium size.
8. Design an Illumination scheme for a medium size Hotel / Hospital /Shopping complex.

**Learning Resources:**

**Books:**

| Sr. No. | Author | Name of Book | Publisher & Address |
|---|---|---|---|
| 1. | Jack L. Lindsey | Applied Illumination Engineering | The Fairmont Press Inc. |
| 2. | R. H. Simons, Robert Bean | Lighting Engineering: Applied Calculations | Architectural Press (ISBN 0750650516) |
| 3. | Casimer M Decusatis | Handbook of Applied Photometry | Springer (ISBN 1563964163) |

Subject : Microprocessor & Microcontroller
Subject Code : CSE 503
Total Hours : 42
Full Marks : 80 + 20 = 100

OBJECTIVES:

The student should be made to:

Study the Architecture of 8085 and 8086 microprocessor.

 Learn the design aspects of I/O and Memory Interfacing circuits.

 Study about communication and bus interfacing.

Study the Architecture of 8051 microcontroller.

UNIT I THE 8085 MICROPROCESSOR 4 Hrs

Introduction to 8085 – Microprocessor architecture , pin out diagram, – Addressing modes - Instruction set, Interrupts and interrupt service routines.

UNIT II THE 8086 MICROPROCESSOR 8 Hrs

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – concept of pipelining, Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT III 8086 SYSTEM BUS STRUCTURE 6 Hrs

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure - Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations.

UNIT IV I/O INTERFACING 6 Hrs

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT V MICROCONTROLLER 6 Hrs

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT VI INTERFACING MICROCONTROLLER 9 Hrs

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.

TEXT BOOKS:


1 Microprocessor Architechture, Programming and Applications with 8085 by Ramesh K Goankar, Galgotia Pub

2 Digital Computer System by Malvino ( 2nd Ed) TMH

3. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007.

4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.

REFERENCE: 1. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012


## Subject : Microprocessor & Microcontroller Lab
## Subject Code : ELE512

**LIST OF EXPERIMENTS:**

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations

2. Move a data block without overlap

3. Code conversion, decimal arithmetic and Matrix operations.

4. Floating point operations, string manipulations, sorting and searching

5. Password checking, Print RAM size and system date

6. Counters and Time Delay

7. Traffic light control

8. Stepper motor control

9. Digital clock

Key board and Display

11. Printer status

12. Serial interface and Parallel interface

13. A/D and D/A interface and Waveform Generation using 8051

14. Basic arithmetic and Logical operations

15. Square and Cube program, Find 2"s complement of a number

16. Unpacked BCD to ASCII

Subject : Programmable Logic Controller
Subject Code : ECE505
Total Hours : 42
Full Marks : 80 + 20 = 100

1. PLC Basics : 6 hrs
   An Overall Look at Programmable Logic Controllers - Introduction, definition & history of the PLC, manufacturing & assembly process, PLC advantage & disadvantage, overall PLC system, CPU & programmer/monitors, PLC input & output modules, printing PLC information. The PLC: A Look Inside - Introduction, the PLC as a computer, the central processing unit, solid state memory, the processor, I/O modules, power supplies. General PLC Programming Procedures - Introduction, programming equipment, programming formats, proper construction of PLC ladder diagrams, process scanning consideration, PLC operational faults. Devices to Which PLC Input and Output Modules Are Connected - Introduction, input ON/OFF switching device, input analog device, output ON/OFF device, output analog devices
2. PLC Programming : 6 hrs
   Programming On/Off Inputs to Produce On-Off Outputs - Introduction, PLC input instruction, output: coils, inductors & others, operational procedures, contact & coil input/output programming examples, a look at fail safe circuit, industrial process examples. Relation of Digital Gate Logic to Contact/Coil Logic - Digital logic gates, Boolean algebra PLC programming, conversion examples. Creating Ladder Diagrams from Process Control Descriptions - Ladder diagram & sequence listing, large process ladder diagram construction, flow charting as programming method
3. PLC Functions : 6 hrs
   Register - Introduction, general characteristics of registers, module addressing, holding registers, input registers: single & group, output registers: single & group. PLC Timer Functions - Introduction, PLC timer functions, examples of timer function industrial application, industrial process timing application. PLC Counter Functions - Introduction, PLC counters examples of counter function industrial application
4. Intermediate Functions : 6 hrs
   PLC Arithmetic Functions - Introduction, PLC addition & subtraction, the PLC repetitive clock, PLC multiplication, division & square-root: PLC trigonometric & log function, other PLC arithmetic functions. PLC Number Comparison Functions - Introduction, PLC basic comparison function, PLC basic comparison function application, PLC advanced comparison function. Numbering Systems and PLC Number Conversion Functions - Introduction, numbering system: decimal, binary & BCD, PLC conversion between decimal & BCD, OCTAL & HEX DECIMAL numbering system, other numbering & code system
5. Data Handling Functions 6 hrs
   The PLC SKIP and MASTER CONTROL RELAY Functions - Introduction, the SKIP function & application, the MASTER CNTROL RELAY function & application. Jump Functions - Introduction, jump with non-return, jump with return. PLC Data Move Systems - Introduction, PLC MOVE function & application, moving large blocks of PLC data, PLC table & registers moves, other PLC MOVE functions.

Other PLC Data Handling Functions - Introduction, PLC FIFO functions, the FAL function, the one shot (ONS), clear (CLR) & SWEEP functions

6. Working with Bits 8 hrs
   PLC Digital Bit Functions and Applications - Introduction, bit pattern in a register, changing a register bit status, shift register function, shift register application. PLC Sequencer Functions - Introduction, electromechanical sequencing, the basic PLC sequencer function, a basic PLC sequencer application with timing, other PLC sequencer function, cascading sequencer. Controlling a Robot with a PLC - Introduction, basic two axis ROBOT with PLC sequencer control, industrial three axis ROBOT with PLC control. PLC Matrix Functions - Introduction, applying matrix functions to reduce program length, the PLC AND & OR matrix function, the PLC COMPLEMENT & OMPARE matrix function, combination PLC matrix operation
7. Advanced PLC Functions : 4 hrs
   Analog PLC Operation - Introduction, types of PLC, analog modules & systems, PLC analog signal processing, BCD or multi-bit data processing, PLC analog output application examples.

**Subject : Programmable Logic Controller Lab**
**Subject Code : ELE513**

List of Experiments:

1 Study of PLC
2 Input instruction of PLC
3 Output operation of PLC
4 Conditional Control statement
5 Unconditional control statement
6 Creating and realizing logic gates
7 Data handling
8 Working with bits
9 Developing Robot functions
10 Multi bit data processing

Books :


1. Programmable Logic Controllers : Principles & Applications, John W. Webb and Ronald A.Reis, Prentice Hall India
2. Programmable Logic Controllers by Bolton, Elsever N Publication
3. Programmable Logic Controllers by FD Prestrusela, TMH
4. Programmable Logic Controllers: Programming Methods and Applications by John R. Hackworth and Frederick D. Hackworth Jr, Pearson

Subject : Maintenance of Electrical Machines (Elective-II)
Subject Code : ELE507
Full Marks : 80+20=100
Hours : 42

1. **Safety and Accidents - 6 Hrs**
   Definition of terminology used in safety: Safety, hazard, accident, major accident hazard, responsibility, authority, accountability, monitoring.
   I.E. Act & statutory regulations for safety of persons and equipment working with electrical installation, causes of electrical accidents, preventive measures, electrical shocks, precaution to be taken against electrical shock, treatment for electrical shock. Causes of electrical fires, precaution to be taken to avoid fire, action to be taken in case of fire, fire fighting equipments.
2. **General Introduction - 7 Hrs**
   Concept of routine, preventive and breakdown maintenance, Advantages of preventive maintenance, procedure for developing preventive maintenance schedule, factors affecting preventive maintenance schedule. Introductionto total productive maintenance.
3. **Maintenance of Rotating machines 7 Hrs**
   Routine, preventive and breakdown maintenance of 1& 3 phase induction motors, Synchronous machines and D.C machines
4. **Maintenance of transformer 6 Hrs**
   Preventive and routine maintenance of distribution transformers, Periodic checks for replacement of oil, Silica gel, properties of a good transformer oil.
5. **Maintenance of insulation 6 Hrs**
   Classification of insulating, factors affecting life of insulating materials, measurement of insulation resistance, interpretation of conditions, agents that contaminate insulating oil, tests on insulating oil (a) Acidity test (b) Sludge test (c) Crackle test (d) flash point test
   Filtration of insulating oil for protection of electrical equipments (insulation) during period of inactivity.
   Procedure for cleaning, washing and drying insulation and revarnishing
   Methods of internal heating & vaccum impregnation.
6. **Troubleshooting of electrical machine & switchgear. 10 Hrs**
   Significance of trouble shooting of various electrical machines and describes the procedure for the same. Internal and external causes of failure of equipment, various types of faults (mechanical, electrical of magnetic) in electrical machines, Reason for their occurrences, use of following tools: Bearing puller, Filler gauge, dial indicator, spirit level, megger, earth tester, growler,
   Trouble shooting charts for 1 & 3 phase induction motor, 1 & 3 Phase transformer.
   List the common trouble in electrical installation and cables.

Maintenance and trouble shooting of LVS switchgear like MCCB, ELCB, Contactors & Batteries.

Subject : Maintenance of Electrical Machines Lab (Elective-II)
Subject Code : ELE514

**List of Practical's**

1. Safety precautions in lab while doing electrical work
2. Safety equipments study
3. Winding of Fan coil
4. Winding of single motor
5. Winding of three phase motor
6. Repairing of single phase transformer
7. Repairing of wiring system
8. Installation of machine
9. Repairing of starter
10. Repairing of mains
11. Study of various types of MCB and other circuit breakers

Books :-


1. Electricals Protection & Switchgear by S.S. Rao
2. Maintenance of Electrical Machine by J.B. Gupta
3. Testing Commisioning Operation & Maintenance Of Electrical Equipment by S. Rao
4. Installation Maintenance And Repair Of Electrical Machines And Equipments by Madhvi Gupta
5. Testing And Maintenance Of Electrical Machines by B.P. Patil

Subject : Control System (Elective-II)
Subject Code : ECE 406
Full Marks : 80+20=100
Hours : 42

PART A

CONTROL SYATEM 4 Hrs

1. **Introduction:** Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, brief idea of multivariable control systems.

2. **Mathematical Modeling of Physical Systems**: 6 Hrs
Representation of physical system (Electro Mechanical) by differential equations, Determination of transfer function by block diagram reduction techniques and signal flow method, Laplace transformation function, inverse Laplace transformation

3. **Time Response Analysis of First Order and Second Order System**: 8 Hrs
Characteristic Equations, response to step, ramp and parabolic inputs. Transient response analysis, steady state errors and error constants, Transient & steady state analysis of LTI systems

4**. Control System Components:** 4 Hrs
Constructional and working concept of ac servomotor, synchronous and stepper motor

**5. Stability and Algebraic Criteria:** 4 Hrs
Concept of stability and necessary conditions,
Routh-Hurwitz criteria and limitations. Root Locus Technique: The root locus concepts, construction of root loci.

**6. Frequency Response Analysis**: 6 Hrs
Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots

**7. Stability in Frequency Domain:** 4 Hrs
Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, M and N Loci, Nichols chart.

**8.** Study of preliminary considerations of lead, lag and lead-lag networks, closed loop systems using compensation techniques in time domain and frequency domain. 4 Hrs

**Controllers :** Brief idea of proportional, derivative and integral controllers. 2 Hrs

**BOOKS:**


1. I. J.Nagrath and M.Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition, 2007.
2. Benjamin.C.Kuo, “Automatic control systems”, Prentice Hall of India, 7th Edition,1995.
3. M.Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 2nd Edition, 2002.
4. Schaum’s Outline Series, “Feed back and Control Systems” Tata Mc Graw-Hill, 2007.
5. John J.D’Azzo & Constantine H.Houpis, “Linear Control System Analysis and Design’”, Tata Mc Graw-Hill, Inc., 1995.
6. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 1999.
7. Automatic Control System by Hasan Syeed


**Subject : Control System Lab (Elective-II)**

**Subject Code : ECE 409**

List of Practical-

1. Transfer function of first and second order system
2. Syncros system control system study
3. AC position servo system study
4. DC position servo system study
5. Control through magnetic amplifier
6. Measurement of passive elements using Bridge Networks
7. Study of transducers and characterization
8. Digital simulation of linear systems
9. Stability Analysis of Linear system using MATLAB or equivalent Software
10. Study the effect of P, PI, PID controllers using MATLAB or equivalent Software
11. Design of Lead and Lag compensator

Subject - Instrumentation System
Subject Code – ECE503
Total Hours 42
Full Marks - 80 + 20 = 100

**Unit I**

**Electronic Meters: 6 hrs**

Electronic Analog voltmeter: DC voltmeters-Choppers type-DC amplifier, solid state voltmeter, Differential voltmeter, peak responding voltmeter, True RMS voltmeter, calibration of DC voltmeters. Digital Voltmeter:- Introduction, Ramp Techniques, dual slope, integrating type DVM, Successive approximation type DVM, Resolution and sensitivity of digital meters, general specification of a DVM. CRO's study of various stages in brief, measurement of voltage, current phase and frequency, special purpose oscilloscope.

**Unit II**

**Instrumentation for Generation and Analysis of Waveforms: 6 hrs**

Signal generators: Fixed and variable AF oscillators, AF sine and square wave generator, Function generator: Square and pulse generator, Sweep generator, wave analyzer, harmonic distortion analyzer, spectrum analyzer, spectrum analysis.

**Unit III**

**Storage and Display Devices: 4 hrs**

Necessity of recorders, recording requirements, graphic recorders, strip chart recorders, magnetic tape recorders, digital tape recorders. Electronic indicating instruments, seven segment display, fourteen segmental display Nixie tube.

**Unit IV**

**Transducers and DATA Acquisition Systems: 6 hrs**

Strain gauge, LVDT, thermocouple, piezoelectric, crystal and photoelectric transducers and their applications. Data acquisition systems. Unit VII Telemetry: Introduction, method of data transmission, types of telemetry systems and applications.

**UNIT V**

**Instrumentation: 6 hrs**

Types of Instrumentation systems, Data acquisition system (DAS) and its uses in intelligent Instrumentation system, Detailed study of each block involved in making of DAS, Signal Conditioners: as DA, IA, Signal Converters (ADC & DAC), Sample and hold, Designing of Pressure, Temperature measuring instrumentation system using DAS, Data logger.

UNIT VI

**Automation 4 hrs**

Introduction about Automation system, Concepts of Control Schemes, Types of Controllers, Components involved in implementation of Automation system i.e., DAS, DOS, Converter ( I to P ) and Actuators: Pneumatic cylinder, Relay, Solenoid (Final Control Element), Computer Supervisory Control System (SCADA), Direct Digital Control's Structure and Software.

**UNIT VII**

**Plc & Intelligent Controller: 10 Hrs**

Introduction of Programmable logic controller, Principles of operation, Architecture of Programmable controllers, Programming the Programmable controller. Introduction to Intelligent Controllers, Model based controllers, Predictive control, Artificial Intelligent Based Systems, Experts Controller, Fuzzy Logic System and Controller, Artificial Neural Networks, Neuro-Fuzzy Controller system.

Subject - Instrumentation Lab
Subject Code: ECE512
Full marks 50

**List of Experiments:-**

1. To determine output characteristic of a LVDT and determine its sensitivity.
2. Study characteristics of temperature transducer like Thermocouple, Thermistor and RTD with implementation of small project using signal conditioning circuit.
3. Study characteristics of Light transducer like Photovoltaic cell, Phototransistor and Pin Photodiode with implementation of small project using signal conditioning circuit.
4. To study input- output characteristics of a potentiometer and to use two potentiometers as an error detector.
5. To study transmitter- receiver characteristics of a synchro set to use the set as control component.
6. To study the operation of a d-c positional servo system and to investigate the effect of damping and supply voltage on its response.
7. To study the operation of an a.c. position servo-system and to obtain effects of supply voltage and system parameter on its transient response.
8. To study a stepper motor and control its direction speed and number of steps with the help of a microprocessor
9. ADC Converter
10. DAC converters
11. Study of Automation system
12. Intelligent controllers

**Suggested Readings / Books:**


1 Electrical and Electronic Measurements and Instrumentation, by K. SAWHNEY.
2 Electronic Instrumentation and Measurement Techniques, by D Cooper.
3 Electronic Instrumentation, by H.S. Kalsi, Tata McGraw Hill
4 Applied Electronics Instrumentation and measurement, David Buchla, Wayne Melachlan:
5 Electronics Measurement and Instrumentation, Oliver by B.H and Cag J.M. McGrawHill.
6 Element of Electronic Instrumentation & Measurement, by Carr, Pearson Education.
7 Electronic Measurements & Instrumentation, by Kishore, Pearson Education.
8 Process Control Systems and Instrumentation, Bartelt, Cengage Learning
9 Process Control Instrumentation Technology‖ 6/e, by Curtis D Johnson, Pearson Ed.
10 Computer-Based Industrial Control‖, by Krishna Kant, PHI.

Subject : Robotics & Smart System (Elective-II)
Subject Code : ELE508
Full Marks : 80+20=100
Hours : 42

**Module-I** **[4Hrs]**

**Fundamentals:** Define Robot, Classification of Robots, Define Robotics, History of Robotics, Advantage and Disadvantages of Robots, Robot Components, Robot Sensing, Robot Degree of Freedom, Robot Joints, Robot Coordinates, Robot Reference Frames, Programming Modes, Robot Programming Language, Robot Applications.

**Module-II** **[4 Hrs]**

**Robot Arm Kinematics:** Robots as Mechanisms, Conventions, Matrix Representation: Representation of a Point in Space; Representation of a Vector in Space, Representation of Rigid Body, The Direct Kinematics Problem, The Inverse Kinematics Solution

**Module-III** **[3 Hrs]**

**Robot Arm Dynamics:** Lagrange-Euler Formulation, Newton-Euler Formation, Effective Moments of Inertia, Generalized D'Alembert Equation of Motion.

**Module-IV** **[4 Hrs]**

**Panning of Manipulator Trajectories:** Path versus Trajectory, Basics of Trajectory Planning, General Consideration on Trajectory Planning, Joint-interpolated Trajectories, Planning of Manipulator Cartesian Path Trajectories.

**Module-V** **[8 Hrs]**

**Control of Robot Manipulators:** Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices, Electric Motors: AC Motors; DC Motors; Servomotors; Stepper Motors, Microprocessor Control of Electric Motors, Magneto strictive Actuators, Speed Reduction.

**Module-VI** **[8 Hrs]**

**Sensors:** Sensor Characteristics, Sensor Utilization, Position Sensors: Potentiometers; Encoders; LVDT; Resolves; LMDT; Hall-effect Sensors, Velocity Sensors: Encoders; Tachometers; Differentiation of Position Signals, Acceleration Sensors, Force and Pressure Sensors: Piezoelectric; Force Sensing Resistor; Strain Gauge, Torque Sensors, Micro switches, Visible Light and Infrared Sensors, Touch Sensors, Proximity Sensors, Range Finder, Sniff Sensors,.

**Module-VII** **[5 Hrs]**

**Robot Programming Languages:** Characteristics of Robot Level Languages, A brief about AL and AML robot programming languages, Position Specification, Motion Specification, Sensing and Flow of Control, Programming Support, Characteristics of Task Level Languages, World Modelling, Task Specification, Robot Program Synthesis, Concluding Remarks.

Subject : Robotics & Smart System (Elective-II)
Subject Code : ELE515

**List of Experiments:**

1. Configure the working of robots
2. Demonstrate the different types of sensor in robotics
3. Interface sensors using Microprocessor or Microcontroller
4. Measure various parameters of Electro-Mechanical Instruments Pressure, Flow, Speed and Moisture
5. Interface Actuators using Microprocessor or Microcontroller
6. Interface Drives using Microprocessor or Microcontroller
7. Interface Stepper Motor using Microprocessor or Microcontroller
8. Use robot trainer to perform different tasks
9. Develop a Program for Line Follower Configuration.
10. Develop a Program for coffee maker configuration

**Reference Books:**

1. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill Education (India Ed.)
2. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Application 2/E", Wiley India Edition
3. S.K. Saha, "Introduction to Robotics 2/E", McGraw Hill Education (India Ed.)
4. R.K. Mittle, I.J. Nagrath, "Robotics and Control", McGraw Hill Education (India Ed.)
5. Thomas R. Kurfess, "Robotics and Automation Handbook", CRC Press
6. Ashitava Ghosal, "Robotics: Fundamental Concepts and Analysis 1/E", Oxford University Press

Subject Title : Development of Life Skills (Common Paper)
Subject Code : 502
Full Marks : 50

**Rationale**:

In today's competitive world, the nature of individual and organizations is changing at very rapid speed. In this situation the responsibility of diploma holder is not unique. After completing his course work he has to face the world and seek meaningful employment also. Merely having knowledge is not sufficient these days. He has to show his communicative skill also. As such the individual skills with capability to show his strength and communicate his willingness new skills for further advancement with to impart his ability and acquiring has to be displayed and learned.

This subject will develop the student as an effective individual to grab the available situation and be member of the unseen team in which he may be put in . It will develop the abilities and skills to perform at highest degree of quality as an individual as well as a member of core group or team. Such skills will enhance his capabilities in the field of searching, assimilating information, managing the given task, handling people effectively, solving challenging problems.

**Objectives:** The students will be able to:

1. Develop acumen to face interview.
2. Lead in the group discussion and set goals and targets for others
3. Develop team spirit i.e. concept of working in teams
2. Apply problem solving skills for a given situation
3. Use effective presentation techniques
4. Apply techniques of effective time management
5. Apply task management techniques for given projects
6. Enhance leadership traits
7. Resolve conflict by appropriate method
8. Survive self in today's competitive world
9. Follow moral and ethics
11. Convince people to avoid frustration

**CONTENTS:**

**SOCIAL SKILLS**

1. Social understanding for group discussion, imaginative thinking and develop free ideas .
2. SWOT Analysis – Concept, and know himself in details. Learn how to make use of SWOT.
3. **Inter personal Relation:-** How to effectively counter arguments of others without hearting their feeling Sources of conflict and conflict resolution, Ways to enhance interpersonal dependence and relations.

4. **Problem Solving**

**I) STEPS IN PROBLEM SOLVING,**

1) Identify and clarify the problem,
2) Information gathering related to problem,
3) Evaluate the evidence,

4) Consider alternative solutions and their implications,
5) Choose and implement the best alternative,
6) Review

II) **Problem solving technique**.(any one technique may be considered)

1) Trial and error
2) 2) Brain storming
3) 3) Lateral thinking

**5. Presentation Skills**

Body language --

Dress like the audience, Posture, Gestures, Eye contact and facial expression. STAGE FRIGHT,

Voice and language – Volume, Pitch, Inflection, Speed, Pause, Pronunciation, Articulation, Language, Practice of speech. Use of presentation aids, Summarizing the facts

**6. Group discussion** –

Introduction to group discussion, Ways to carry out group discussion, Parameters— Contact, body language, analytical and logical thinking, decision making

**7. INTERVIEW TECHNIQUE**

Necessity, Techniques to influence interviews and giving directions, Tips for handling common questions.

**8. Working in Teams**

Understand and work within the dynamics of a groups.

Tips to work effectively in teams,

Establish good rapport, interest with others and work effectively with them to meet common objectives,

Tips to provide and accept feedback in a constructive and considerate way ,

Leadership in teams, Handling frustrations in group.

**9. Task Management**

Introduction, Task identification, Task planning ,organizing and execution, Closing the task

**BOOKS:**

| Sr. No | Title of the book | Author | Publisher |
|---|---|---|---|
| 1 | Adams Time management | Marshall Cooks | Viva Books |
| 2 | Basic Managerial Skills for All | E.H. Mc Grath , S.J. | Pretice Hall of India |
| 3 | Body Language | Allen Pease | Sudha Publications Pvt. |
| 4 | Creativity and problem solving | Lowe and Phil | Kogan Page (I) P Ltd |
| 5 | Decision making & Problem Solving | by Adair, J | Orient Longman |
| 6 | Develop Your Assertiveness | Bishop , Sue | Kogan Page India |
| 7 | Make Every Minute Count | Marion E Haynes | Kogan page India |
| 8 | Organizational Behavior | Steven L McShane and Mary Ann Glinow | Tata McGraw Hill |
| 9 | Organizational Behavior | Stephen P. Robbins | Pretice Hall of India, Pvt Ltd |
| 10 | Presentation Skills | Michael Hatton ( Canada – India Project) | ISTE New Delhi |
| 11 | Stress Management Through Yoga and Meditation | -- | Sterling Publisher Pvt Ltd |
| 12 | Target setting and Goal Achievement | Richard Hale ,Peter Whilom | Kogan page India |
| 13 | Time management | Chakravarty, Ajanta | Rupa and Company |
| 14 | Working in Teams | Harding ham .A | Orient Longman |

**INTERNET ASSISTANCE**

1. http://www.mindtools.com
2. http://www.stress.org
3. http://www.ethics.com
4. http://www.coopcomm.org/workbook.htm
5. http://www.mapfornonprofits.org/
6. http://www.learningmeditition.com http://bbc.co.uk/learning/courses/
7. http://eqi.org/
8. http://www.abacon.com/commstudies/interpersonal/indisclosure.html
9. http://www.mapnp.org/library/ethics/ethxgde.htm
10. http://www.mapnp.org/library/grp_cnfl/grp_cnfl.htm
11. http://members.aol.com/nonverbal2/diction1.htm
12. http://www.thomasarmstron.com/multiple_intelligences.htm
13. http://snow.utoronto.ca/Learn2/modules.html
14. http://www.quickmba.com/strategy/swot/