UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VI SEMESTER

ELECTRICAL AND ELECTRONICS ENGINEERING

SCHEME -2013

VI SEMESTER

ELECTRICAL AND ELECTRONICS ENGINEERING (E)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.601	Advanced Control Systems (E)	4	2	2	-	50	3	100	150
13.602	Induction Machines and Special Machines(E)	3	2	1	-	50	3	100	150
13.603	Microprocessors & Applications (E)	4	2	2	-	50	3	100	150
13.604	Numerical Techniques & Computer Programming(E)	3	2	1	-	50	3	100	150
13.605	Power System Analysis and Stability(E)	4	2	2	-	50	3	100	150
13.606	ELECTIVE II	3	2	1	-	50	3	100	150
13.607	Microprocessor Lab (E)	2	-	-	2	25	2	50	75
13.608	Software Lab(E)	2	-	-	2	25	2	50	75
13.609	Systems & Control Lab(E)	4	-	-	4	50	3	100	150
	Total	**29**	**12**	**9**	**8**	**400**		**800**	**1200**

13. 606 Elective II

13.606.1	Biomedical Instrumentation (E)
13.606.2	Optical Instrumentation (E)
13.606.3	Switched Mode Power Converters (E)
13.606.4	Finite Element Methods (E)
13.606.5	Soft Computing (E)
13.606.6	Software Engineering (E)

13.601 ADVANCED CONTROL THEORY

Teaching Scheme: 2(L) - 2(T) - 0(P) **Credits**: 4

Course Objective:

- *To provide a strong foundation on the advanced control system analysis and design techniques and to expose the students to analysis of the discrete time systems.*
- *To provide s foundation to the various analysis techniques applied to the nonlinear system, which is necessary during implementation of controllers designed through linear approximation.*

Module – I

State space analysis of systems: Introduction to state concept - state equation of linear continuous time systems, matrix representation of state equations. Phase variable and canonical forms of state representation- solution of time invariant autonomous systems-state transition matrix- relationship between state equations and transfer function. Properties of state transition matrix- controllability & observability. State feed-back design via pole placement technique.

Module – II

Sampled data control system. Sampling process - Z transform method- pulse transfer function- system time response by Z transform method - analysis of the sampling process - data reconstruction and hold circuits - zero order hold circuit - Sampling theorem. Stability of sampled data system -Routh Hurwitz criterion and Jury's test. Introduction to state-space representation of sampled data systems.

Module – III

Nonlinear systems : Introduction - characteristics of nonlinear systems. Types of non-linearities. Analysis through Linearisation about an operating point. Analysis through harmonic linearisation - Determination of describing function of static nonlinearities (memoryless static nonlinearities only) - application of describing function for stability analysis of autonomous system with single nonlinearity.

Module – IV

Phase Plane Analysis: Concepts- Construction of phase trajectories for nonlinear systems and linear systems with static nonlinearities - Singular points – Classification of singular points -Limit cycle.

Definition of stability- asymptotic stability and instability - Liapunov methods to stability of linear and nonlinear, continuous and discrete time systems.

References:

1. Katsuhiko Ogata, *Modern Control Engineering*, Fourth edition, Pearson Education, New Delhi, 2002.
2. Chi-Tsong Chen, *Analog and Digital Control System Design: Transfer Function, Statespace and Algebraic Methods*, Sounders College Publishing, New York.
3. Norman S. Nise , *Control Systems Engineering*, 5th Edition, Wiley Eastern, 2007.
4. Nagarath I. J and Gopal M, *Control System Engineering*, Wiley Eastern, New Delhi.
5. Gopal M, *Modern Control System Theory*, Wiley Eastern Ltd., New Delhi.
6. Kuo B.C, *Analysis and Synthesis of Sampled Data Systems*, Prentice Hall Publications.
7. Hassan K Khalil, *Nonlinear Systems*, Prentice - Hall International (UK), 2002.
8. Jean-Jacques E. Slotine & Weiping Li, *Applied Nonlinear Control*, Prentice-Hall., NJ, 1991.
9. Alberto Isidori, Nonlinear Control Systems, Springer Verlag, 1995.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should be set to check the analytical, design, and application skills. Descriptive questions should not exceed 20% of the maximum marks.*

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Solve linear time invariant systems using state transition matrix.*
- *Design modern controller to various systems in time domain.*
- *Analyse stability of digital/sample data systems*

- *Solve difference equations using Z-transform method*
- *Implement the controllers in discrete domain using digital computers*
- *Analyse the system including the complex nonlinearities at the final stage of implementation of linear controllers.*

13.602 INDUCTION MACHINES AND SPECIAL ELECTRICAL MACHINES (E)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objectives:

To expose the students to the concepts of induction machines including the constructional details, principle of operation and Performance analysis. It also give the basic concept of principle of operation of special machines.

Module – I

Three phase induction motor, constructional features - slip ring and cage types - Theory of induction motor with constant mutual flux - slip - phasor diagram - expression for mechanical power and torque - torque-slip characteristics - starting torque - full load and pull out torque - equivalent circuit. Circle diagrams - tests on induction motors for determination of equivalent circuit and circle diagram. Cogging, crawling and noise production in cage motors - remedial measures. Effect of unbalance in supply voltage.

Module – II

Boucherot's double cage motor - equivalent circuit - approximate current locus - torque-slip curves.

Starting of induction motors - DOL starter - auto transformer starting - star-delta starting - rotor resistance starting. Inter lock and over load protection - comparison of different starting methods. Starting current and starting torque.

Speed control - stator voltage control – V/f control, Cascaded Control - rotor resistance control.

Braking –different methods. Induction generator - principle - phasor diagram – circle diagrams - applications - comparison with synchronous generators. Self-excited induction generator, Synchronous induction motor - circle diagram.

Module – III

Single-phase induction motor - double field revolving theory - equivalent circuit - torque slip curve - types : split phase & shaded pole - applications. AC Commutator motors - single phase series motor - construction - phasor diagram - universal motor. AC Servomotors-Construction-principle of operation-performance characteristics- applications- DC servomotors-field and armature controlled DC servomotors- permanent magnet armature controlled – applications.

Module – IV

Stepper motors-Basic principle - construction –types- comparison – applications.

Reluctance motors- Principle of operation- torque equation -torque slip characteristics applications. Switched reluctance motors.

Brushless DC motor- construction - types -comparison– applications.

Linear induction motor – principle – different types – applications – magnetic levitations.

References

1. Say M.G, *Performance and Design of AC Machines*, ELBS and PITMAN Publishing Ltd.
2. Langsdorf A. S., *Theory of AC Machines*, Tata McGraw Hill, New Delhi
3. Fitzgerald and Kingsly, *Electrical Machinery*, McGraw Hill
4. D. R. Gupta, Vandana Singhal, *Fundamentals of Electric Machines*, New Age International
5. Open Shaw Taylor E. , *Performance and Design of AC Commutator Motors*, Ah Wheeler & Co. Ltd.
6. Theodore Wilde, Electrical Machines, *Drives and Power System*, Pearson Ed. Asia 2001.
7. Janardanan E. G., *Special Electrical Machines*, PHI learning Pvt Ltd, Delhi, 2011.
8. Krishnan R., Motor Drives - *Modeling, Analysis and Control*, 2001, Ddhanushka.
9. Venkataratnam K., *Special Electrical Machines,* Universities Press (India) Pvt Ltd, 2008.
10. Irving L. Kossov, *Electrical Machinery and Transformers*, Pearson Education South Asia, Second Edition.
11. Simmi P Burman, *Special Electrical Machines*, S.K. Kataria & Sons; 2013 edition.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

After the successful completion of this course, the students will be able to:

- *Identify suitable drive depending on speed and torque requirement*
- *Compute efficiency of induction machines*
- *Justify and select appropriate starters for induction motors*
- *Implement various speed control technique as demanded by the industry*
- *Distinguish and conclude on selection of various motors used in house hold appliances*
- *Select the proper induction motor or a special electrical machine for a given application, based on a performance analysis.*

13.603 MICROPROCESSORS & APPLICATIONS (E)

Teaching Scheme: 2(L) - 2(T) - 0(P) **Credits**: 4

Course Objectives:

The objective of this course is to provide a strong foundation about the principles, programming and various applications of different microprocessors and commonly used interfacing IC 8255.

Module – I

Internal architecture of 8085 microprocessor – pin out diagram - Instruction set of 8085- Instruction format – opcodes and operands – Addressing modes – Classification of instructions. Assembly language programming – assembler directives – assemblers and cross assemblers – program debugging. Development of standard programs in assembly language – code conversion, sorting – binary and BCD arithmetic. Stack and Subroutines – conditional CALL and RETURN instructions – stack operations, Delay subroutines.

Module – II

Timing and control – Machine cycles and clock states – fetch and execute cycles – Timing diagram for instructions.

IO and memory interfacing - Interfacing memory – Address decoding – Methods of data transfer – synchronous and asynchronous data transfer, Programmed data transfer – interrupt driven data transfer – interrupt structure of 8085.

Module – III

Internal Architecture of 8086 Bus interface unit and execution unit – Segment Registers - Instruction Pointer – Flag Register – Index Registers - Stack Pointer Register. Segmentation and Pipe lining. Minimum and maximum modes of operation of 8086. Addressing modes- Instruction set of 8086 – Assembly language programming, Simple programs.

Module – IV

I/O ports--Programmable peripheral interface PPI 8255- Modes of operation. Interfacing of LEDs, ADC and DAC with 8085 –Interfacing of matrix keyboard and printer with 8086.

Review of 32 bit processors –80386,80486and 80586 and its built in features. (block diagram or programming not required).

References:

1. Ramesh Gaonkar, *Microprocessor, Architecture, Programming and Applications*, Penram International Publishing; Sixth edition, 2014.

2. Mathur A., *Introduction to Microprocessors*, Tata McGraw Hill, New Delhi, 1992.
3. Ram , *Microprocessors & Applications*, Dhanpat Rai Publications (P) Ltd, New Delhi.
4. Naresh Grover, *Microprocessors*, Dhanpat Rai Publications (P) Ltd, New Delhi.
5. Douglas V. Hall, *Microprocessors and Interfacing*, Tata McGraw Hill, Education, New Delhi, Third Edition.
6. M. Rafiquzzaman, *Microprocessor Theory and Application*, PHI Learning, First Edition.
7. Ray Ajoy and Burchandi, *Advanced Microprocessor & Peripherals*, Tata McGraw Hill, Education, New Delhi, Second Edition.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be able to

- *Develop standard assembly language programs using 8085 instruction set.*
- *Develop simple assembly language programs using 8086*
- *To interface systems with microprocessors using 8255PPI*
- *To solve engineering problems using microprocessors.*

13.604 NUMERICAL TECHNIQUES & COMPUTER PROGRAMMING (E)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

This course will enable the students to acquire the programming skills by learning the fundamental concepts of C programming language and develop programs to solve engineering problems using numerical methods.

Module – I

Introduction, basic data types in C, input/output, operators – expression – unary, binary and ternary operators.

Decision making – if and switch case. Loops – for, while and do while, Break - continue. Structured data types– array, structure and union.

Module – II

Functions - storage classes – recursive functions. Pointers – array Vs pointer – array of pointers, pointer to a structure – implementation of stack and queue using pointers - pointer to a function.

Dynamic allocation of memory, command line arguments. File handling in C – unformatted and formatted files.

Module – III

Programming examples in C for the solution of linear equations using Gauss and Gauss Jordan elimination methods- determinant and inverse of matrices – Eigen value and eigenvectors, Solution of transcendental equations using Newton-Raphson method, Bisection method.

Module – IV

Programming examples in C for the solution of numerical integration –Trapezoidal and Simpson's 1/3 rule, numerical solution of ordinary and partial differential equations- Euler's method – Rungakutta method.

References:

1. Stephen G Kochan, *Programming in C*, CBS Publishing Co. Third Edition.
2. Brian W Kernighan & Dennis M Ritchie, *The C Programming language* Prentice Hall - India-Second Edition.

3. Krishnamurthy E. V. and S.K.Sen: *Computer Based Numerical Algorithms*, Affiliated East-West press Pvt. Ltd., 2001.
4. Press W.H., S.A. Teukolsky, W.T. Vetterling and B.P. Flannery, *Numerical Recipes in C*, Cambridge University Press, Third Edition.
5. Grewal B.S., *Numerical Methods and Computer Programming*, Khanna publishers, New Delhi.
6. Jose S.,*Computer Programming and Numerical Methods*, Pentagon Educational Services, Kollam, 2015.
7. Balagurusamy E., *Numerical Methods*, Tata McGraw-Hill Education, 2001.
8. M. K. Jain, S. R. K. Iyengar, R. K. Jain, *Numerical Methods for Scientific and Engineering Computations*, New Age International Ltd, 2008.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Develop application based program in any computer language.*
- *Apply numerical methods for solving engineering problems using C programming.*
- *Design programs using different data structures*
- *Develop C programs using files*

13. 605 POWER SYSTEM ANALYSIS AND STABILITY (E)

Teaching Scheme: 2(L) - 2(T) - 0(P) **Credits:** 4

Course Objectives:

This course will enable the students to analyse power systems under normal and abnormal conditions.

Module – I

Basic Concepts in Power Systems-Power in single phase AC circuits –Complex Power-Power triangle-Power in balanced 3 phase ac circuits- Per unit quantities-single phase and three phase-selection of base quantities -advantages of per unit system –changing the base of per unit quantities-Simple problems.

Modelling of power system components - single line diagram –per unit quantities. Symmetrical components- sequence impedances and sequence networks of generators, transformers and transmission lines.

Introduction to need for power system protection - Methods of analyzing faults in symmetrical and unsymmetrical case- effects of faults - Power system faults - symmetrical faults - short circuit MVA - current limiting reactors-Unsymmetrical faults - single line to ground, line to line, double line to ground faults -consideration of prefault current-problems.

Module – II

Load flow studies – Introduction-types-network model formulation - formation of bus impedance and admittance matrix, Gauss-Siedel, Newton-Raphson (Qualitative analysis only) and Fast Decoupled methods-principle of DC load flow.

Module – III

Economic Operation - Distribution of load between units within a plant - transmission loss as a function of plant generation - distribution of load between plants - Method of computing penalty factors and loss coefficients.

Unit commitment: Introduction — Constraints on unit commitments: Spinning reserve, Thermal unit constraints- Hydro constraints.

Module – IV

Automatic Generation and Voltage Control: Load frequency control: single area and two area systems -Automatic voltage control. Power system stability - steady state, dynamic and transient stability-power angle curve-steady state stability limit Mechanics of angular motion-Swing equation - Point by Point method - RK method - Equal area criterion application - Methods of improving stability limits.

References:

1. Stevenson W. D., *Elements of Power System Analysis*, 4/e, McGraw Hill, 1982.
2. Wadhwa C. L., *Electrical Power Systems*, 33/e, New Age International, 2004.
3. Weedy B. M., B. J. Cory, N. Jenkins, J. B. Ekanayake and G. Strbac, *Electric Power System*, John Wiley & Sons, 2012.
4. Kothari D. P. and I. J. Nagrath, *Modern Power System Analysis*, 2/e, TMH, 2009.
5. Gupta B. R., *Power System Analysis and Design*, S. Chand, New Delhi, 2006.
6. Uppal S. L. and S. Rao, *Electrical Power Systems*, Khanna Publishers, 2009.
7. Cotton H. and H. Barber, Transmission & Distribution of Electrical Energy, 3/e, Hodder and Stoughton, 1978.
8. Soni, M.L., P. V. Gupta and U. S. Bhatnagar, *A Course in Electrical Power*, Dhanpat Rai & Sons, New Delhi, 1984.
9. Gupta J.B., Transmission *& Distribution of Electrical Power*, S.K. Kataria & Sons, 2009.
10. Hadi Saadat, *Power System Analysis*, 2/e, McGraw Hill, 2002.
11. Kundur P., *Power system Stability and Control*, McGraw Hill, 1994.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Compute the fault MVA and fault current for different faults on simple power systems*
- *Conduct load flow analysis manually by Gauss Siedel method*
- *Solve Economic Dispatch problem for simple systems*
- *Formulate and solve Unit Commitment problem*
- *Develop and solve Automatic Generation Control*
- *Identify different stability issues*

13.606.1 BIOMEDICAL INSTRUMENTATION (E) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

- *To provide a strong foundation about the instrumentation systems, selection of the appropriate sensors necessary for the measurement of human variables and to expose the students, to the measurement of bioelectric potentials related to cardiovascular, respiratory nervous and muscular systems.*
- *To provide foundation to the various imaging technologies which help the clinical doctors in the diagnosis, instruments which assists therapy of diseases and patient safety.*

Module – I

Human Physiology systems and transducers: Problems encountered in measuring living systems. Cardio-vascular, respiratory, nervous and muscular systems of the body. Bioelectric potential - Resting and action potential - Generation, and propagation. Bioelectric potentials associated with physiology systems (ECG, EEG and EMG).

Basic types of electrodes for bio-potential measurement (micro, skin surface and needle electrodes). Transducers for the measurement of Pressure, flow, temperature and respiration rate-(piezo-electric, resistive, capacitive and inductive types).

Module – II

The cardiovascular and Respiratory system measurements: Heart and cardiovascular system and circulation block diagram, blood pressure and its measurement - Direct and indirect methods. characteristics of blood flow and heart sounds. Measurement of Blood flow. Measurement of Heart rate.

Electrocardiography: ECG lead configurations, Block diagram, ECG recording and ECG waveform.

Respiratory system measurements- Lung volumes and capacities. Spirometer, Measurement of Respiration rate using thermistor, Co_2 method, Using displacement transducer and Impedance pneumography.

Module – III

Nervous system and its measurements: The anatomy of nervous system, Neuronal communication. Measurements from the nervous system.

Electroencephalography- Lead system, Position of Electrodes, EEG Block diagram, EEG waveforms and features. Brain-Computer interfacing.

Electromyography- block diagram of EMG recorders, EMG waveforms and features. Applications

Elements of intensive care units- Bed side monitors- Block diagram.

Module – IV

Modern imaging systems: Basic x-ray machines, CAT scanner- Principle of operation, scanning components, Ultrasonic imaging principle, types of Ultrasound imaging, MRI and PET scanning.(Principle only)

Therapeutic equipments Cardiac pace makers, de-fibrillators, hemo-dialysis machines, artificial kidney, short wave and Micro wave diathermy machines.

Patient Safety: Shock hazards – leakage current – safety and test instruments.

References:-

1. Khandpur R. B., *Handbook of Biomedical Instrumentation*, Prentice Hall of India, New Delhi, 2003.
2. Joseph J. Carr and John M. Brown, *Introduction to Biomedical Equipment Technology*, Pearson Education India, Delhi, 2004.
3. Leslie Cromwell, *Biomedical Instrumentation and Measurements*, Prentice Hall of India Pvt. Ltd, New Delhi, 2nd Edition, 2004.
4. John G. Webster (Editor), *Medical Instrumentation, Application and Design*, John Wiley and sons.
5. S K Venkata Ram, *Biomedical Electronics and Instrumentation*, Galgotia Publishing, New Delhi.2000.
6. Raja Rao C.and S.K.Guha, *Medical Electronics and Biomedical Instrumentation*, Universities Press, 2007.
7. Sarbadhikari S.N., *Biomedical Engineering*, Universities Press, 2006.
8. Arumugham M., *Biomedical Instrumentation*, Anuradha Agencies Publishers, Kumbakonam, 2006.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

1. *Apply science and engineering concepts to solve problems at the various stages of measurement of human variables.*
2. *Design an instrumentation system, selecting the appropriate sensors to meet desired needs in biomedical instrumentation considering patient safety measures.*
3. *Plan and conduct experiments as well as analyze and interpret experimental data collected on physical systems and living systems*
4. *Illustrate the imaging technologies to help the clinical doctors in the diagnosis and therapy of diseases.*
5. *Be independent learners who can master new knowledge and technologies and successfully engage in further education and research combining engineering and biomedical sciences*

13.606.2 OPTICAL INSTRUMENTATION (E) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

This course introduces fundamental principles of light sourcing and different types of LASERS and applications. It also provides exposure to various optical components and opto-electronic devices and provides a foundation of basic principles, design methodology, and practical considerations needed to design or use optical instruments in engineering practice.

Module – I

Light Sourcing: Transmitting and Receiving Concept of Light, Basic light sources and its Characterization, Polarization , Coherent and Incoherent sources, Grating theory , Application of diffraction grating, Electro-optic effect ,Acousto-optic effect and Magneto-optic effect.

Properties of laser, Laser modes, Lasers Classification: Ruby lasers, Neodymium Lasers, HeNe Lasers, CO2 Lasers, Dye Lasers, Semiconductors Lasers , Laser Applications.

Module – II

Opto –Electronic devices and Optical Components : Photo diode, PIN, Photo-Conductors, Solar cells, ,Phototransistors, Materials used to fabricate LEDs, Response times of LEDs ,LED drive circuitry.

Optical Fiber Sensors Active and passive optical fiber sensor, Intensity modulated, displacement type sensors, Multimode active optical fiber sensor (Microbend sensor) Single Mode fiber sensor-Phase Modulates and polarization sensors.

Module – III

Laser Interferometry: Radio-metry, types of interference phenomenon and its Application, Michelson's Interferometer and its application Fabry-perot interferometer, Refractometer, Rayleigh's interferometers, Spectrographs and Monochromators, Spectrophotometers, Calorimeters, Speckle pattern instruments: Speckle properties, speckle in single point interferometers and electronic speckle pattern Interferometry.

Module – IV

Holography:The basic principles of Holography, viewing a hologram, volume hologram, multiplex hologram, white light reflection hologram. Measurement of strain, stress, bending moments and vibration by Holography, nondestructive testing, medical and dental research, solid mechanics.

Laser vibrometry: short distance, medium distance and long distance vibrometry.

Laser Doppler Velocimetry: Principle of operation, performance parameters: Medical Optical Instruments.

References:-

1. Ajoy Ghatak, *OPTICS*, Tata McGraw Hill, New Delhi, III Edition.
2. Nagabhushana S., N. Sathyanarayana, *Lasers and Optical Instrumentation*, IK International Pvt Ltd, 2010.
3. Wilson J. and JFB Hawkes, *Optoelectronics – An Introduction*, Prentice Hall of India Pvt. Ltd. New Delhi, 2003.
4. Silvano Donati, *Electro-Optical Instrumentation*, Pearson Education, Inc., 2004.
5. Joseph T Verdeyen, *Laser electronics*, Prentice-Hall of India Pvt. Ltd., second edition.
6. Stephen A. Benton V. Michael Bove, Jr. *Holographic Imaging*, John Wiley & sons, inc., Publication
7. Sunil Verma, Yogesh M. Joshi, K. Muralidhar *Optical interferometers: Principles and Applications in Transport Phenomena*,
   ‘www.nptel.ac.in/courses/112104039/sup_4/article4.pdf.
8. Charles M. Vest, *Holographic Interferometry*, John Wiley & Sons.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Get broad theoretical exposure to fundamental concepts of Lasers, different types of Lasers and important optical phenomena.*

- *Analyze simple optical systems consisting of Opto –Electronic devices and Optical Components and fibre optic sensors.*
- *Get thorough understanding of Laser Interferometry, different types of interferometers, holography, laser vibrometry and Laser Doppler velocimetry.*

13.606.3 SWITCHED MODE POWER CONVERTERS (E) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

To expose the student to the various power converters like switched mode DC-DC converters, DC-AC converters and Resonant converters.

Module – I

Linear Power supplies- Introduction to Switched Mode DC-to-DC Converter –
Step-down converters - Continuous Conduction mode – Boundary between continuous and discontinuous conduction – Output voltage ripple
Step-up converters - Continuous Conduction mode – Boundary between continuous and discontinuous conduction – Discontinuous conduction mode
Buck Boost converters - Continuous Conduction mode – Boundary between continuous and discontinuous conduction – Output voltage ripple.
Full Bridge dc-dc Converter – PWM with bipolar voltage and unipolar voltage Switching – dc-dc converter comparison.

Module – II

Switched Mode DC-to-AC Converter: Introduction to Switched Mode DC-to-AC Converter – Basic concepts – PWM switching scheme – square wave switching scheme – single and three phase inverters – switching utilization – ripple in inverter output – effect of blanking time on voltage in PWM inverters. Square wave pulse switching – programmed harmonic elimination switching – current regulated modulation.

Module – III

Resonant Converters- Introduction – Switch mode inductive current switching – Zero voltage and Zero current switching. Classification of Resonant Converters – Basic Resonant Circuit concepts – Load Resonant Converters – Series Loaded and Parallel Loaded Resonant dc-dc converters (Discontinuous conduction mode only) -Resonant switch Converters (ZCS and ZVS.

Module – IV

Switching DC supplies with isolation – dc to dc converters with electrical isolation – fly back converters – double ended fly back converters – forward converters – double ended forward converters – push pull converters – half bridge converters – full bridge converters
Power line disturbances – Power conditioners – Uninterruptible power supplies.

References:-

1. Ned Mohan, Tore M Undeland & W. P. Robbins, *Power Electronics: Converters, Applications, and Design,* 3rd Edition**,** John Wiley and Sons, 2007.
2. Abraham Presman, *Switching Power Supply Design*, McGraw Hill. 2009, III Edition.
3. Ramanarayanan V., Course Material on *Switched Mode Power Conversion*, Department of Electrical Engineering, Indian Institute of Science, Bangalore 560012. http://minchu.ee.iisc.ernet.in/new/people/faculty/vr/book.pdf.
4. Vithayathil J., *Power Electronics-Principles and Applications*, Tata McGraw Hill, 2010.
5. Rashid M. H., *Power Electronic Circuits, Devices and Applications*, Pearson Education, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

Design and analyse various power converters like switched mode DC-DC converters, DC-AC converters and Resonant converters circuits and choose appropriate converter circuit for a specified application.

13.606.4 FINITE ELEMENT METHODS (E) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

- *To expose the students to the fundamentals Finite Element Analysis.*
- *To have a thorough understanding of the FEM analysis so that the students can utilize the knowledge for the modeling and analysis of Electrical Engineering systems using some commercial Finite Element Analysis softwares.*

Module – I

Review of electromagnetics- Review of co-ordinate systems, Divergence, curl. Electrostatic boundary value problems-Poisson and Laplace's equations, Maxwell's equation. Magnetic potential – Force due to magnetic field. Lorentz force equation. Maxwell's stress tensor. Magnetic torque.

Module – II

Introduction to Finite element method - historical background, applications, advantages, finite element softwares. Numerical solutions- Finite Difference Method, Finite Element method- Energy minimization- variational methods.

One dimensional FE analysis - discretisation of domain into elements - generalised coordinates approach - derivation of elements equations - assembly of element equations- Boundary conditions.

Module – III

2D Finite element modeling - Discretization, Mesh generation and numbering. Shape functions. Rayleigh-Ritz and Galerkin approaches to Finite Elements. Galerkin method for Poisson's equation- numerical examples. Normal gradient boundary conditions – Forced and natural boundary conditions - Imposition of Dirichlet boundary condition.

Module – IV

Elements of CAD systems- Preprocessing, modeling, meshing – Material properties – Boundary conditions – setting up solutions – case study (Case study of a Finite Element Analysis of a machine using a standard software).

References:-

1. Sadiku M.N.O, *Numerical Techniques in Electromagnetics*, CRC Press Edition-2001.
2. Peter P silvester, Ronald L Ferran, *Finite Elements for Electrical Engineers* Cambridge University press, III edition.

3. Bianchi N., *Electrical Machine Analysis Using Finite Elements*, CRC. Taylor & Francis, 2005.
4. Ratnajeevan S. & H. Hoole, *Computer-aided Analysis and Design of Electromagnetic Devices*, Elsevier Publishers.
5. Chandrupatla T. R. and A. D. Belagundu, *Introduction to Finite Elements in Engineering*, Pearson Education, 2012.
6. Krishnamoorthy C. S., *Finite Element Analysis: Theory and Programming*, Tata McGraw Hill, 2005.
7. David V.Hutton, *Fundamentals of Finite Element Analysis*, Tata McGraw-Hill, 2005.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

Solve engineering problems using FEM analysis and also to utilize the knowledge for the modeling and analysis of electrical engineering systems using standard Finite Element Analysis softwares.

13.606.5 SOFT COMPUTING TECHNIQUES (E) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

This course is intended to provide the students knowledge of various conventional nonlinear optimization methods, soft computing methods and artificial intelligent techniques and to apply these methods for design, analysis, operation and control of complex electrical systems.

Module – I

Statement of a nonlinear Optimization problem. Unconstrained and constrained optimization problem. Derivative- based Optimization –Descent Methods–The Method of Steepest Descent –Classical Newton's Method (Quantitative analysis for the specified methods alone)–Step Size Determination Derivative-free Optimization.

Module – II

Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Perceptrons and the LMS Algorithm, Limitations of the Perceptron Model.– Back propagation Mutilayer Perceptrons –Radial Basis Function Networks –Unsupervised Learning Neural Networks –Competitive Learning Networks –Kohonen Self-Organizing Networks.

Module – III

Introduction to classical sets -properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods. Fuzzy logic control.

Module – IV

Genetic Algorithms - Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, Initialization and selection, Genetic operators, Mutation, Generational Cycle, Applications, Characteristics. Simulated Annealing.

References:-

1. Rao S. S., *Engineering optimization: Theory and Practice*, New Age International (P) Limited, 3rd edition, 1998

2. Simon Haykin, *Neural Networks-A comprehensive foundation*, Pearson Education, 2001.
3. Timothy J Ross, *Fuzzy Logic with Engineering Applications*, McGraw-Hill, 1997.
4. Davis E. Goldberg, *Genetic Algorithms: Search, Optimization and Machine Learning*, Addison Wesley,N.Y.,1989.
5. Rajasekaran S. and G. A. V. Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms*, PHI, 2003.
6. Sivanandam S. N., S. Sumathi, and S. N. *Deepa Introduction to Neural Networks using MATLAB*, TMH, 2006.
7. James A Freeman and Davis Skapura, *Neural Networks*, Pearson Education, 2002.
8. Dimitri P. Bertsekas, *Nonlinear Programming*: 2nd Edition, 2004.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Explain formulation of non-linear optimization problem.*
- *Choose appropriate optimization techniques for various management/engineering problems.*
- *Correlate engineering optimization problems with concepts like GA and simulated annealing.*
- *Explain the ANN structure and its applications in various fields.*
- *Illustrate fuzzy logic and fuzzy control.*
- *Design fuzzy controller for real life applications.*

• 13.606.6 SOFTWARE ENGINEERING (E) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

To assist the student in understanding the basic theory of software engineering, and to apply these basic theoretical principles to a group software development project.

Module – I

Introduction: Introduction to software engineering Software Crisis, Software Processes.

Software life cycle models: Waterfall, Prototype, Evolutionary and Spiral models, Overview of Quality Standards like ISO 9001, SEI-CMM

Software Metrics: Size Metrics like LOC, Token Count, Function Count, Design Metrics, Data Structure Metrics, and Information Flow Metrics.

Software Project Planning: Cost estimation, static, Single and multivariate models, COCOMO model, Putnam Resource, Allocation Model, Risk management.

Module – II

Computer Arithmetic - Constructing an arithmetic logic unit - A 32 bit ALU, Basic Operations - Signed and unsigned addition - carry look ahead adder, subtraction, Multiplication algorithm - Booths algorithm, Division algorithm.

Control unit - Hardwired control and micro-programmed control - grouping of control signals – microinstruction with next field address - Pre-fetching of microinstructions - Emulation.

Module – III

Software Testing: Software process, Functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Structural testing: Path testing, Data flow and mutation testing, unit testing, integration and system testing, Debugging, Testing Tools & Standards.

Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Reverse Engineering, Software Re-engineering.

Module – IV

Interface Design and CASE: GUI design - advantages - types of user interfaces. Styles of human-computer interaction - Human-Computer interface design - interface design models. Computer Aided Software Engineering (CASE) tools - Tool integration - object management -

Analysis and design tools - programming tools - Integration and testing tools - Maintenance tools.

References:-

1. Pressman R. S., *Software Engineering – A Practitioner's approach*, 5th edition., McGraw Hill Int.
2. Aggarwal K.K. & Yogesh Singh, *Software Engineering*, 3rd edition, New Age International, 2007.
3. Rajib Mall, *Fundamentals of Software Engineering*, 2nd edition ,Prentice Hall of India, 2006
4. Fairley R., *Software Engineering Concepts*, Tata McGraw Hill, 1997.
5. Jalote P., *An Integrated approach to Software Engineering*, Narosa, 1991.
6. Stephen R. Schach, *Classical & Object Oriented Software Engineering*, IRWIN, 1996.
7. James Peter, W Pedrycz, *Software Engineering*, John Wiley & Sons.
8. Sommerville, *Software Engineering*, Addison Wesley, 1999.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Define and understand the requirements, analyze, design and develop various software solutions*
- *To plan, schedule and execute software projects.*
- *To verify and validate various software products*
- *To model and implement software solutions*

13.607 MICROPROCESSOR LAB (E)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

This course will enable the students to get practical knowledge to develop and execute programs for microprocessor based applications in electrical and electronics engineering.

List of Experiments:

1. Study of 8085 Microprocessor kit and Instruction set.
2. Data transfer instructions using different addressing modes and block transfer.
3. Arithmetic operations in binary and BCD-addition, subtraction, multiplication and division.
4. Logical instructions- sorting of arrays in ascending and descending order.
5. Binary to BCD conversion and vice versa.
6. Digital I/O using PPI-square wave generation.
7. Interfacing D/A converter- generation of simple waveforms-triangular wave, ramp etc
8. Interfacing A/D converter
9. Study of 8086 microprocessor.-8 bit and 16 bit multiplication and division.
10. Stepper motor control (8085).
11. D.C. motor control-interfacing of 12 V PMDC motor (8085).

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed

80% - Initial work (Algorithm and program)- (30%);

Implementation/ Execution of program - (30%)

Results and inference- (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

Upon successful completion of this course, students will be able to:

1. *Develop and execute programs to perform data transfer, arithmetic& logical operations. and code conversions using 8085 microprocessors and basic arithmetic operations using 8086.*
2. *Generate square wave using 8085 microprocessor and to interface using PPI 8255.*
3. *Make use of 8085 microprocessor for speed and position control of dc motor and stepper motor*

13.608 SOFTWARE LAB (E)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

This course will enable the students to get practical knowledge in the development and implementation of C programs for solving engineering problems using numerical methods.

List of Experiments:

1. Simple programs using input output statements
2. Simple programs using decision statements
3. Programs using Control statements
4. Array manipulation
5. Functions Pass by value Pass by reference
6. Recursive functions
7. String manipulation – compare, copy, reverse operations
8. Matrix operations: addition multiplication, determinant and inverse
9. Reading from a file and writing to a file merging and appending of files.
10. Solution of algebraic and transcendental equations: Bisections, Newton- Raphson method- comparison
11. Numerical Integration – Trapezoidal rule, Simpson's 1/3rd rule-comparison.
12. Solution of set of linear equations-Gauss, Gauss-Jordan, Gauss-Siedel- comparison
13. Solution of differential equation – Euler, Runge-Kutta, step size- comparison

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed

80% - Initial work (Algorithm and program)- (30%);

Implementation/ Execution of program - (30%)

Results and inference- (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Carry out numerical integration and solve linear equations, differential equations and transcendental equations using numerical methods through C programs*
- *Solve complex electrical engineering problems using C programs.*

13.609 SYSTEMS AND CONTROL LABORATORY (E)

Teaching Scheme: 0(L) - 0(T) - 4(P) **Credits**: 4

Course Objective :

This course will enable the students to develop mathematical models for electrical systems and implement controllers and compensators for systems based on system performance.

List of Experiments:

1. Predetermination and verification of frequency response characteristics of Lag and Lead networks.
2. Transfer Function of AC and DC servomotors
3. Step and frequency response of R-L-C circuit
4. Study of various types of synchros (TX, TR & TDX). Characteristics of transmitter, data transmission using TX-T R pair. Effect of TDX in data transmission.
5. Study of P, PI and PID controllers. Response analysis of a typical system with different controllers using process control simulator.
6. Study of performance characteristics and response analysis of a typical temperature/ Flow/ Level control system.
7. MATLAB: Use of control system Tool box for the Time domain and frequency domain methods of system analysis and design
8. SIMULINK: Simulation and control of real time systems using SIMULINK
9. Compensator design using Bode plot with MATLAB control system Tool box
10. Programmable Logic controller(PLC): To control a simple process using PLC

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed

80% - Circuit and Design- (30%);

Performance - (30%)

Results and inference- (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

Upon successful completion of this course, students will be able to:

- *Develop mathematical models for servomotors and other electrical systems*
- *Performance analysis of different process control systems*
- *Performance analysis of different types of controllers*
- *Use MATLAB and SIMULINK to design and analyze simple systems and compensators.*