INSTITUTE OF ENGINNERING AND TECHNOLOGY LUCKNOW

(An Autonomous Constituent Institute of Dr. A.P.J. Abdul Kalam Technical University, Lucknow)

Evaluation Scheme & Syllabus

For

B. Tech. Fourth Year
(Electrical Engineering)

On

Choice Based Credit System

[Effective from the Session: 2019-20]

EVALUATION SCHEME

B-TECH. ELECTRICAL ENGINEERING

YEAR 4ᵗʰ / SEMESTER-VII

S. No.	Subject Code	Subject Name	Department	L-T-P	Th./Lab Marks ESE	Sessional CT	Sessional TA	Total	Credit
1		OPEN ELECTIVE COURSE-1	Other Deptt.	3--0--0	70	20	10	100	3
2		DEPTT ELECTIVE COURSE-3	Core Deptt.	3--0--0	70	20	10	100	3
3		DEPTT ELECTIVE COURSE-4	Core Deptt.	3--1--0	70	20	10	100	4
4	REE701	ELECTRICAL DRIVES	Core Deptt.	3--1--0	70	20	10	100	4
5	REE702	POWER SYSTEM PROTECTION	Core Deptt.	3--0--0	70	20	10	100	3
6	REE751	INDUSTRIAL AUTOMATION & PLC LAB	Core Deptt.	0--0--2	50		50	100	1
7	REE752	POWER SYSTEM LAB	Core Deptt.	0--0--2	50		50	100	1
8	REE753	INDUSTRIAL TRAINING	Core Deptt.	0--0--3			100	100	2
9	REE754	PROJECT-1	Core Deptt.	0--0--6			200	200	3
	TOTAL				450	100	450	1000	24

DEPTT. ELECTIVE COURSE-3
1. **REE070: Microprocessors and Microcontrollers**
2. **REE071: Utilization of Electrical Energy & Electric Traction**
3. **REE072: Introduction to Smart Grid**
4. **REE073: Power System Optimization**

DEPTT. ELECTIVE COURSE-4
1. **REE075: Industrial Automation and Control**
2. **REE076: Energy Efficiency & Conservation**
3. **REE077: Reliability Engineering**
4. **REE078: Electric Machine Design**

EVALUATION SCHEME

B-TECH. ELECTRICAL ENGINEERING

YEAR 4th / SEMESTER-VIII

S. No.	Subject Code	Subject Name	Department	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					ESE	CT	TA		
1		OPEN ELECTIVE COURSE-2	Other Deptt.	3--0--0	70	20	10	100	3
2		DEPTT ELECTIVE COURSE-5	Core Deptt.	3--1--0	70	20	10	100	4
3		DEPTT ELECTIVE COURSE-6	Core Deptt.	3--0--0	70	20	10	100	3
4	REE851	GD & SEMINAR	Core Deptt.	0--0--3			100	100	2
5	REE852	PROJECT-2	Core Deptt.	0--0--12	350		250	600	12
	TOTAL				560	60	380	1000	24

DEPTT. ELECTIVE COURSE-5
1. **REE080: Advanced Control System**
2. **REE081: Introduction to Power Quality & FACTS**
3. **REE082: Power System Dynamics, Control and Monitoring (NPTEL)**
4. **REE083: Computer Aided Power System Analysis**

DEPTT. ELECTIVE COURSE-6
1. **REE085: EHVAC &DC Transmission**
2. **REE086: Power Theft & Energy Management**
3. **REE087: Digital Image Processing**
4. **REE088: Antennas (NPTEL)**

REE701	ELECTRIC DRIVES	L T P: 3 1 0	4 Credit

UNIT-I: Fundamentals of Electric Drive:

Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of load, Load torque: components, nature and classification.

UNIT-II

Dynamics of Electric Drive:

Dynamics of motor-load combination, Steady state stability of Electric Drive, Transient stability of electric Drive

Selection of Motor Power rating:

Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty., Load equalization

UNIT-III

Electric Braking:

Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors

Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking.

UNIT-IV

Power Electronic Control of DC Drives:

Single phase and three phase-controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited dc motor and dc series motor.

UNIT-V

Power Electronic Control of AC Drives:

Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based) static rotor resistance and slip power recovery control schemes.

Three Phase Synchronous motor: Self-controlled scheme

Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications

Text Books:

1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House.

2. S.K.Pillai, "A First Course on Electric Drives", New Age International.

3. V Subrahmanyam, "Electric Drives", Mcgrawhill Education

Reference Books:

1 M.Chilkin, "Electric Drives",Mir Publishers, Moscow.

2 Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore.

3 N.K. De and Prashant K.Sen, "Electric Drives", Prentice Hall of India Ltd.

4 V.Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill.

| REE702 | POWER SYSTEM PROTECTION | L T P: 3 0 0 | 3 Credit |

Unit I: Introduction to Protection System:

Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology.

Relays: Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay, design considerations of electromagnetic relay.

Unit-II: Relay Application and Characteristics:

Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay

Static Relays: Comparison with electromagnetic relay, classification and their description, over current relays, directional relay, distance relays, differential relay.

Unit-III: Protection of Transmission Line:

Over current protection, distance protection, pilot wire protection, carrier current protection, protection of bus, auto re-closing.

Unit-IV: Circuit Breaking:

Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings.

Testing of Circuit Breaker: Classification, testing station and equipment, testing procedure, direct and indirect testing.

Unit-V: Apparatus Protection:

Protection of Transformer, generator and motor.

Circuit Breaker: Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and d. c. circuit breakers.

Text Books:
1. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
3. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Mc. Graw Hill

Reference Books:

4. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.

5. T.S.M Rao, "Power System Protection: Static Relays with Microprocessor Applications" Tata Mcgraw Hill".

6. A.R. Van C. Warrington,"Protective Relays- Their Theory and Practice, Vol. I & II" John Willey & Sons.

REE751	INDUSTRIAL AUTOMATION & PLC LAB	L T P: 0 0 2	1 Credit

Note: - Experiments shall be performed on following virtual lab links:

For Industrial Automation (minimum 5 experiments):

- **http://ial-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering**

For PLC (minimum 5 experiments):

- **http://plc-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering**

REE752	POWER SYSTEM LAB	L T P: 0 0 2	1 Credit

Note: - At least 10 experiments should be performed out of which 3 should be simulation based.

(A) Hardware Based:

1. To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.

2. To determine negative and zero sequence reactances of an alternator.

3. To determine sub transient direct axis reactance (xd) and sub transient quadrature axis reactance (xq) of an alternator

4. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation

5. To study the IDMT over current relay and determine the time current characteristics

6. To study percentage differential relay

7. To study Impedance, MHO and Reactance type distance relays

8. To determine location of fault in a cable using cable fault locator

9. To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.

10. To study operation of oil testing set.

(B) Simulation Based Experiments (using MATLAB or any other software)

11. To determine transmission line performance.

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator

13. To obtain formation of Y-bus and perform load flow analysis

14. To perform symmetrical fault analysis in a power system

15. To perform unsymmetrical fault analysis in a power system

Text Books:

1. Hadi Sadat, "Power System Analysis" Tata McGraw Hill.

2. T.K. Nagsarskar & M.S. Sukhija, Power System Analysis' Oxford University Press.

REE070	MICROPROCESSORS AND MICROCONTROLLERS	L T P: 3 0 0	3 Credit

Unit-I: Mode of operation of higher order processors: Real mode and protected mode Real mode and protected mode memory addressing, access right byte, Memory paging, System descriptors, Multi Tasking & TSS.

Unit-II: Instruction Set of higher order processors (8086 to Pentium): Comparison with 8086 in real mode: Generalized instruction set format Addressing Mode: DRAM & BRAM Categorization of instruction set of INTEL processors. Integer instructions: Data transfer instructions, arithmetic and logical operations, string instructions, branch control instructions, procedure call instruction and return instruction.

Unit-III: Processing of CALLS, INTERRUPTS & EXCEPTIONS: Privilege levels; ENTER and LEAVE Instructions, INT N. IRET. Interrupt processing sequence, Protected mode interrupts.

Unit-IV: Assembly Level Programming: ROM BIOS Routines, MS DOS BIOS Routines, Assembling a progam using Assembler, exe and. com programs. Mixed Language Programming: using Assembly with C/C ++

Unit-V: Microcontrollers: Introduction, basic functions, applications of 8-bit and 16-bit microcontrollers.

8-bit microcontrollers INTEL 8051: Internal Architecture, signals, memory organization and interfacing, Timing and control, port operations, interrupts and I/O addressing. Instruction Set and programming.

16-bit microcontrollers INTEL 8096: Architectural description, memory Organization and interfacing, I/O addressing, Interrupts, instruction set and programming.

Text Books:

1. Ray, A.K. & Burchandi, K.M., "Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing" Mc. Graw Hill.
2. Renu Sing & B.P. Singh, "Advanced Microprocessors and Microcontrollers" New Age International.
3. Krishna Kant, "Microprocessors and Microcontrollers" PHI Learning.
4. Brey, Barry B. "The INTEL Microprocessors" Pearson Education.

Reference Books:

1. Ayala, "The 8051 Micro Controller", Centage Learning.
2. Mazidi M.A., Maizidi J.G. Mckinlay R.D., "The 8051 Microcontroller and Embedded Systems" Pearson Education.
3. Rajkamal, "The concept and feature of microcontrollers 68HC11, 8051 and 8096", S.Chand Publisher, New Delhi
4. Peatman John, "Design with microcontroller", Mc.-Graw Hill Publishing.

| REE071 | UTILIZATION OF ELECTRICAL ENERGY AND TRACTION | L T P: 3 0 0 | 3 Credit |

Unit-I: Electric Heating:

Advantages and methods of electric heating, Resistance heating, Electric arc heating, Induction heating, Dielectric heating

Unit-II: Electric Welding:

Electric Arc Welding Electric Resistance Welding Electronic welding control Electrolyte Process: Principles of electro deposition, Laws of electrolysis, applications of electrolysis

Unit-III: Illumination:

Various definitions, Laws of illumination, requirements of good lighting Design of indoor lighting and outdoor lighting systems Refrigeration and Air Conditioning: Refrigeration systems, domestic refrigerator, water cooler Types of air conditioning, Window air conditioner

Unit-IV: Electric Traction - I

Types of electric traction, systems of track electrification Traction mechanics- types of services, speed time curve and its simplification, average and schedule speeds Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence

Unit-V: Electric Traction – II

Salient features of traction drives Series – parallel control of dc traction drives (bridge transition) and energy saving Power Electronic control of dc and ac traction drives Diesel electric traction.

Text Books:

1. H. Partab, "Art and Science of Electrical Energy" Dhanpat Rai & Sons.

2. G.K. Dubey, "Fundamentals of Electric Drives" Narosa Publishing House

Reference Books:

3. H. Partab, " Modern Electric Traction" Dhanpat Rai & Sons.

4. C.L. Wadhwa, " Generation, Distribution and Utilization of Electrical Energy" New Age International Publications.

REE072	INTRODUCTION TO SMART GRID	L T P: 3 0 0	3 Credit

Unit-I: Introduction:

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

Unit-II: Smart Grid Technologies:

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.

Unit-III: Smart Grid Technologies:

Smart Substations, Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU), PMUs application to monitoring & control of power system.

Unit-IV: Microgrids and Distributed Energy Resources:

Concept of microgrid, need & application of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid, Plastic & Organic solar cells, thin flim solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

Unit V: Power Quality Management in Smart Grid:

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring.

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.
4. Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", Wiley Blackwell 19.
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press.

Reference Books:

6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability", Artech House Publishers July 2011.
7. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
8. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronice and Power Systems)", Springer

9. R.C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication.
10. Phadke, A.G., Thorp, J.S., "Synchronized Phasor Measurements and Their Applications", Springer.
11. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley.

REE073	POWER SYSTEM OPTIMIZATION	L T P: 3 0 0	3 Credit

Unit –I Introduction to optimization and classical optimization techniques Linear Programming:

Standard form, geometry of LPP, Simplex Method pf solving LPP, revised simplex method, duality, decomposition principle, and transportation problem.

Unit –II Non-Linear Problem (NLP):

One dimensional method, Elimination methods, Interpolation methods, Unconstrained optimization techniques-Direct search and Descent methods, constrained optimization techniques, direct and indirect methods.

Unit –III Dynamic Programming:

Multistage decision processes, concept of sub-optimization and principle of optimality, conversion of final value problem into an initial value problem CPM and PERT

Unit –IV Genetic Algorithm:

Introduction to genetic Algorithm, working principle, coding of variables, fitness function. GA operators; Similarities and difference s between Gas and traditional methods; Unconstrained and constrained optimization using Genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA.

Unit –V Applications to Power system:

Economic Load Dispatch in thermal and Hydro-thermal system using GA and classical optimization techniques, Unit commitment problem, reactive power optimization. Optimal power flow, LPP and NLP techniques to optimal flow problems.

Text / Reference Books

1. S.S.Rao,"Optimization - Theory and Applications", Wiley-Eastern Limited.
2. David G. Luenberger,"Introduction of Linear and Non-Linear Programming ", Wesley Publishing Company.
3. Polak,"Computational methods in Optimization ", Academic Press.
4. Pierre D.A., "Optimization Theory with Applications", Wiley Publications.
5. Kalyanmoydeb,"Optimization for Engineering Design: Algorithms and Examples", PHI Publication
6. D.E. Goldberg,"Genetic Algorithm in Search Optimization and Machine Learning ", Addision-Wesley Publication, 1989
7. L.P. Singh,"Advanced Power System Analysis and Dynamics ", Wiley Eastern Limited.
8. Olle I. Elewgerd " Electrical Energy System: An Introduction ", TMH Publication, New Delhi

DEPARTMENTAL ELECTIVE-4

REE075	INDUSTRIAL AUTOMATION AND CONTROL	L T P: 3 1 0	4 Credit

Unit 1: Need and benefit of automation, PLC system: applications of PLC, PLC modules, I/O module, Communication module, PID module, Input analog and digital devices, Output analog and digital devices.

Unit 2: PLC registers, PLC timer function, PLC counter function, PLC simple arithmetic and logical functions, PLC ladder logic diagram, Advanced PLC functions like SKIP, MASTER CONTROL RELAY, JUMP with non return, jump with return, Sequencer function

Unit 3: PLC applications: Bottling filling plant, Material handling elevator, 2-axis robot with sequencer control, Level control, Troubleshooting

Unit 4: Introduction to DCS, concept of DCS, hierarchy of DCS, function of each level of DCS, Introduction to supervisory Control and Data Acquisition system (SCADA), SCADA Architecture, Interfacing SCADA with PLC

Unit 5: Induction motor drive: V/F Control, Direct torque control, Stepper motor drives, AC and DC Servo motor drives, DC motor drives

Text Books:

1 Webb John W. and Reis A. Ronald, "Programmable Logic Controllers Principles and applications" PHI ,New Delhi, Latest edition
2 Bolton W, "Programmable Logic Controllers" Elsevier India Pvt. Ltd. New Delhi
3 John R Hackworth, "Programmable Logic Controllers" Pearson education New Delhi, Latest edition
4 C. D. Johnson, "Process Control Instrumentation" John Wiley & Sons

Reference Books:

1 Liptak, "Instrumentation Engineering Handbook" Chilton Book Company, Latest edition
2 Popovic & Bhatkar, "Distributed Computer Control for Industrial Automation" CRC Press, New Delhi, Latest edition
3 Krishna Kant, "Computer Based Industrial Control" PHI, New Delhi, Latest edition
4 Rashid M. H, "Power Electronics – Circuits, Devices and Applications" PHI / Pearson Education.

REE076	ENERGY EFFICIENCY & CONSERVATION	L T P: 3 1 0	4 Credit

Unit-I: Energy conservation:

Principles of Energy Conservation, Energy conservation Planning, Energy conservation in small scale industries, Large scale industries and in electrical generation, transmission and distribution, Energy conservation Legislation.

Unit-II Energy Audit: Aim of energy Audit, Strategic of Energy Audit, Energy management Team Consideration in implementing energy conservation Programme, Instruments for energy audit, Energy audit of Electrical Systems, HVAC, Buildings, Economic analysis.

Unit-III: Demand Side Management:

Concept and Scope of Demand Side Management, Evolution of Demand Side Management, DSM Strategy, Planning, Implementation and its application, Customer Acceptance & its implementation issues, National and International Experiences with DSM.

Unit-IV: Voltage and Reactive power in Distribution Systems:

Voltage and reactive power calculations and control, Voltage classes and nomenclature, voltage drop calculations, Voltage control, VAR requirements and power factor, Capacitors unit and bank rating, Protection of capacitors and switching, Controls for switched capacitors and fields testing.

Unit-V: Efficiency in Motors and Lighting system:

Load scheduling/shifting, Motor Drives-motor efficiency testing, energy efficient motors, and motor speed control. Lighting- lighting levels, efficient options, fixtures, day lighting, timers, Energy efficient windows, UPS selection, Installation operation and maintenance.

Indian Electricity Act 1956, Distribution Code and Electricity Bill 2003.

Text / Reference Books

1. Tripathy S.C., "Electric Energy Utilization and Conservation', Tata McGraw Hill.
2. Industrial Energy Conservation Manuals, MIT Press, Mass
3. "The Efficient Use of Energy", Edited by I.G.C.Dryden, Butterworths, London
4. Energy Management Handbook, Edited by W.C.Turner, Wiley, New York
5. L.C.Witte, "P.S.Schmidt, D.R.Brown, Industrial Energy Management and Utilization", HemispherePubl, Washington
6. Power Capacitor Handbook, Butterworth & Co (Publishers) Ltd
7. Electrical Systems Analysis and Design for Industrial Plants, Mcgraw-Hill Book Company.
8. IEEE Bronze Book, "Recommended Practice for Energy Conservation and cost effective planning in industrial facilities", IEEE Press

| REE077 | **RELIABILITY ENGINEERING** | L T P: 3 1 0 | 4 Credit |

UNIT I: Introduction

Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness.

UNIT II: Reliability Mathematics

Definition of probability, laws of probability, conditional probability, Bay's theorem; variousdistributions; data collection, recovery of data, data analysis procedures, empirical reliabilitycalculations.

UNIT III: Reliability

Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tie-set methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method.

UNIT IV: Reliability Improvements

Methods of reliability improvement, component redundancy, system redundancy, types ofredundancies- series, parallel, series - parallel, stand by and hybrid, effect of maintenance.

UNIT V: Reliability Testing

Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards.

Text Books :

1. R.Billintan& R.N. Allan,"Reliability Evaluation of Engineering and Systems", Plenum Press.

2. K.C. Kapoor & L.R. Lamberson,"Reliability in Engineering and Design", John Wiley and Sons.

Reference Books:

3. S.K. Sinha & B.K. Kale,"Life Testing and Reliability Estimation", Wiley Eastern Ltd.

4. M.L. Shooman, "Probabilistic Reliability, An Engineering Approach", McGraw Hill.

5. G.H.Sandler,"System Reliability Engineering", Prentice Hall.

| REE078 | **ELECTRIC MACHINE DESIGN** | **L T P: 3 1 0** | **4 Credit** |

Unit I: Fundamental aspects of Electrical Machine Design:

Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.

Electrical Engineering Materials: Desirabilities of Conducting Materials, Comparison of Aluminum and Copper wires. Ferromagnetic Materials: Soft Magnetic materials – Solid Core Materials, Electrical Sheet and Strip, Cold Rolled Grain Oriented Steel. Insulating Materials: Desirable Properties, Temperature Rise and Insulating Materials, Classification of Insulating materials based on Thermal Consideration.

Unit II: Design of DC Machines:

Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.

Unit III: Design of Transformers:

Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.

Unit IV: Design of Three Phase Induction Motors:

Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of NoLoad Current and Leakage Reactance.

Unit V: Design of Three Phase Synchronous Machines:

Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.

Text Books / Reference Books

1. Ramamoorty, M., Computer Aided Design of Electrical Equipment, Eastern Press Private Limited (1989).
2. A.K. Sawhney, a Course in Electrical Machine Design, DhanpatRai& CO. (2013).
3. V. Rajini, V.S. Nagarajan, "Electrical Machine Design", Pearson India.
4. Say, M.G., Design and Performance of Machines, CBS Publications (1981).
5. Hamdi, E.S., Design of Small Electrical Machine, John Wiley and Sons (1994).
6. Smith, S.P. and Say, M.G., Electrical Engineering Design Manual, Chapman and Hall (1984).
7. Walker, J.H., Large AC Machines: Performance and Operation, BHEL (1997).

DEPARTMENTAL ELECTIVE-5

REE080	ADVANCED CONTROL SYSTEM	L T P: 3 1 0	4 Credit

Unit-I: State Space Analysis of Continuous System:

State space analysis, Solution of state equation, determination of state-transition matrix, using Laplace method, Similarity transformation method and Caley-Hamilton Method.

Unit-II: Analysis of Discrete System:

Concept of state feedback design, Determination of controllability Matrix and test of controllability, State feedback controller design via pole placement method, Concept of state observer design, Determination of the observability matrix and test of observability condition, Design of the full state observer using pole placement.

Unit-III: Nonlinear systems:

Nonlinear System Modeling Analysis of Nonlinear system (Inverted Pendulum)via Linearization, Describing function analysis of nonlinear system, Stability Analysis of Nonlinear system using Describing function Analysis.

Unit-IV: Phase Plan Analysis:

Construction of Phase portrait using Isoclines approach, Singular points, Phase plane analysis of 2nd order linear system, Phase plane analysis of nonlinear control system.

Unit-V: Liapunov Stability Analysis:

Concept of stability in the sense of Liapunov. Linear system analysis using Liapunov approach, Determination of Liapunov functions using variable gradient method, Stability analysis of nonlinear systems.

Text Books:

1. M. Gopal, "Digital Control and State variable Methods", Tata Mc Graw Hill.

2. Ajit K. Madal, "Introduction to Control Engineering: Modelling, Analysis and Design" New Age International.

3. K. Ogata, " Modern Control Engineering", PHI.

Reference Books:

1. B.C. Kuo, "Digital Control Systems" Sounders College Publishing

2. C.H.Houpis and G.B.Lamont,"Digital Control Systems:Theory,Hardware, Software" Mc Graw Hill.

| REE081 | INTRODUCTION TO POWER QUALITY & FACTS | L T P: 3 1 0 | 4 Credit |

Unit-I: Introduction to Power Quality:

Terms and definitions of transients, Long duration Voltage Variations: under Voltage, Under Voltage and Sustained Interruptions; Short Duration Voltage Variations: interruption, Sag, Swell; Voltage Imbalance; Notching D C offset, waveform distortion; voltage fluctuation; power frequency variations.

Unit-II: Voltage Sag:

Sources of voltage sag: motor starting, arc furnace, fault clearing etc; estimating voltage sag performance and principle of its protection; solutions at end user level- Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, and Active Series Compensator.

Unit-III: Electrical Transients:

Sources of Transient Over voltages- Atmospheric and switching transients- motor starting transients, pf correction capacitor switching transients, ups switching transients, neutral voltage swing etc; devices for over voltage protection.

Unit-IV: FACT Systems:

Introduction – Terms &Definition,Fact Controllers, Type of FACT devices i.e. SSC, SVC, TSC, SSS, TCSC, UPFC Basic relationship for power flow control.

Unit- V: Harmonics:

Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on – Transformers, AC Motors, Capacitor Banks, Cables, and Protection Devices, Energy Metering, Communication Lines etc., Harmonic Mitigation Techniques.

Text Books:

1. Roger C Dugan, McGrahan, Santoso&Beaty, "Electrical Power System Quality" McGraw Hill
2. Arinthom Ghosh & Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices" Kluwer Academic Publishers
3. C. Sankaran, "Power Quality" CRC Press
4. S. Sivanagaraju& S. Satyanarayana, "Electric Power Transmission and Distribution" Pearson Education
5. Narain G. Hingorani& Laszlo Gyugyi "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems" Wiley

REE082	**POWER SYSTEM DYNAMICS, CONTROL AND MONITORING (NPTEL)**	**L T P: 3 1 0**	**4 Credit**

Refer following web link for course details:

https://onlinecourses.nptel.ac.in/noc19_ee14/preview

REE083	COMPUTER AIDED POWER SYSTEM ANALYSIS	L T P: 3 1 0	4 Credit

UNIT-I: Introduction:

Modern Power Systems Operation and Control, Different types of Power System Analysis.

AC Power Flow Analysis: Introduction, Modeling of Power System Components, Power Flow Equations, Formation of Y_{bus} Matrix, Power Flow Solution Algorithms, Newton Raphson Load Flow Method, Fast Decoupled Load Flow Method and DC Load Flow Method, AC-DC System Power Flow Analysis- Sequential and Simultaneous Solution Algorithms

UNIT-II: Sparse Matrices: Sparsity directed Optimal Ordering Schemes, Solution Algorithms - LU factorization, Bi-factorization and Iterative Methods.

UNIT –III:Analysis of Faulted Power System: Symmetrical and Asymmetrical Faults, Z_{bus} Formulation, Short Circuit Analysis of Large Power Systems using Z_{bus}, Analysis of Open Circuit faults.

UNIT-IV: Security Analysis: Basic Concepts, Static Security Analysis at Control Centers, Contingency Analysis, Contingency Selection.

UNIT-V: Stability Analysis: Classification of Power System Stability, Classical Model of Synchronous Machines and Excitation System, Transient Stability Analysis of Multi-Machine Systems, Eigen Analysis of Dynamical Systems, Small Signal Stability Analysis using Classical Model, Basic Concepts of Voltage Stability Analysis.

Text Books:

1. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis", Tata Mc Graw Hill, 3rd Edition
2. P.S.R. Murty, "Operation and Control in Power Systems", B.S. Publications
3. O.I.Elgerd,Electric Energy Systems Theory - An Introduction, McGraw-Hill, 1988.
4. J.D. Glover, M.Sarma and T.J. Overbye,Power System Analysis and Design, Fourth Edition, Thomson Engineering Press, 2008.
5. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control", John Wiley & Sons

DEPARTMENTAL ELECTIVE-6

REE085	EHV AC & DC TRANSMISSION	L T P: 3 0 0	3 Credit

UNIT-I:

Need of EHV transmission, standard transmission voltage, comparison of EHV AC & DC transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission.

UNIT-II: EHV AC Transmission:

Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferroresonance, reduction of switching surges on EHV system, principle of half wave transmission.

UNIT-III: Extra High Voltage Testing:

Characteristics and generation of impulse voltage, generation of high AC and DC voltages, measurement of high voltage by sphere gaps and potential dividers. Consideration for Design of EHV Lines: Design factors under steady state limits, EHV line insulation design based upon transient over voltages. Effects of pollution on performance of EHV lines.

UNIT-IV: EHV DC Transmission – I:

Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of DC link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of DC link.

UNIT-V:EHV DC Transmission – II:

Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, AC and DC filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.

Text Books:

1.R. D. Begamudre, "Extra High Voltage AC Transmission Engineering" Wiley Eastern.

2.K. R. Padiyar, "HVDC Power Transmission Systems: Technology and System Reactions" New Age International.

3.J. Arrillaga," High Voltage Direct current Transmission" IFFE Power Engineering Series 6, Peter Peregrinus Ltd, London.

4.M. S. Naidu & V. Kamaraju, "High Voltage Engineering" Tata Mc Graw Hill. Reference Books:

5.M. H. Rashid , " Power Electronics : Circuits, Devices and Applications" Prentice Hall of India.

6.S. Rao, "EHV AC and HVDC Transmission Engineering and Practice" Khanna Publisher.

7. "EPRI, Transmission Line Reference Book, 345 KV and above" Electric Power Research Institute. Palo Alto, California, 1982

REE086	**POWER THEFT AND ENERGY MANAGEMENT**	L T P: 3 0 0	3 Credit

UNIT-I: Introduction:

Energy sources, Energy demand and supply, Energy crisis, Future Scenario, Menace of power theft, reasons for power pilferage, electricity loss and theft-National and Global Scenario, Security seals and tampering, harmonics and power theft, Control Over power theft.

UNIT-II: Power Theft in Electro-mechanical Meters:

Power theft in voltage circuit, by-passing meters, drilling holes on Electro-mechanical Meters, Insertion of film into meter, partial earth fault tampering, Missing Neutral Method.

Power Theft in Electronic Meters: Power theft by means of Electrostatic Discharge, Power theft by tampering printed circuit board, Power theft by tampering the frequency circuit, tampering on display circuits of energy meter, Introducing limit switch.

UNIT-III:

Energy system efficiency, Energy conservation aspects, Instrumentation and measurements.

Principles of Energy Management and Energy Audit:

General principles, Planning and program, Introduction to energy audit, General methodology, Site surveys, Energy systems survey, Energy audit, Instrumentation, Analysis of data and results.

UNIT-IV: Electrical Load and Lighting Management:

General Principles, Illumination and human comfort, Lighting systems, Equipment's, Electrical systems, Electrical load analysis, Peak load controls.

Demand Side Management: Concept and Scope of Demand Side Management, Evolution of Demand Side Management. DSM Strategy, Planning, Implementation and its application, Customer Acceptance & its implementation issues, National and International Experiences with DSM.

Text Books:

1. G.Sreenivasan, "Power Theft", PHI Learning Private Limited

2. AmlanChakrabarti, "Energy Engineering and Management", PHI Learning Private Limited

3. W R Murphy, G Mckay, "Energy Management", B.S. Publications

| REE087 | DIGITAL IMAGE PROCESSING | L T P: 3 0 0 | 3 Credit |

Unit-I:Image:

Image formation, image geometry perspective and other transformation, sterio imaging elements of visual perception [60] Digital Image-sampling and quantization serial & parallel Image processing

Unit-II:Signal Processing:

Fourier, Walsh-Hadmard discrete cosine and Hotelling transforms and their properties, filters, correlators and convolvers, Histogram specification, smoothing, sharpening, frequency domain enhancement, pseudo-colour enhancement

Unit-III: Image Restoration:

Constrained and unconstrained restoration Wiener filter, characteristics of Wiener filter, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.

Unit-IV: Segmentation Techniques

Thresholding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques

Unit-V: Practical Applications

Finger print classification, signature verification, text recognition, map understanding, bio-logical cell classification. Analysis of biomedical images, Wavelet Transforms in One Dimension - The Discrete Wavelet Transform and The Continuous Wavelet Transform.

Text Books:

1.Ganzalez and Wood, "Digital Image Processing", Addison Wesley, 1993.

2.AnilK.Jain, "Fundamental of Image Processing", Pearson India.

References:

3.Rosenfeld and Kak, "Digital Picture Processing" vol.I&vol.II, Academic,1982

4.Ballard and Brown, "Computer Vision", Prentice Hall, 1982

5.WayneNiblack, "An Introduction to Digital Image Processing", Prentice

REE088	ANTENNAS (NPTEL)	L T P: 3 0 0	3 Credit

Refer following web link for course details:

https://onlinecourses.nptel.ac.in/noc19_ee19/preview

B.TECH.
VII SEMESTER 2020-21

REVISED OPEN ELECTIVE-I

1.	ROE070	HUMAN VALUES IN SANKHAY YOGA AND VEDANTA DARSAN
2.	ROE071	MODELLING AND SIMULATION OF DYNAMIC SYSTEMS
3.	ROE072	INTRODUCTION TO SMART GRID
4.	ROE073	CLOUD COMPUTING
5.	ROE074	UNDERSTANDING THE HUMAN BEING COMPREHENSIVELY - HUMAN ASPIRATIONS AND ITS FULFILLMENT
6.	ROE075	AUTOMATION AND ROBOTICS
7.	ROE076	COMPUTERIZED PROCESS CONTROL
8.	ROE077	MODELING OF FIELD-EFFECT NANO DEVICES
9.	ROE078	QUALITY MANAGEMENT
10.	ROE079	GIS & REMOTE SENSING
11.	ROE080	HUMAN VALUES IN BUDDHA AND JAIN DARSHAN

ROE 070	**Human Values in Sankhya, Yoga and Vedanta Darshan**	**L**	**T**	**P**	**C**
		3	0	0	3
Version No.:	2.0 (updated as on June 12 '19)				
Prerequisite:	KVE 301/401- Universal Human Values and Professional Ethics				

Objectives:
1. To help students understand the basic principles of Sankhya, Yoga and Vedanta Darshan
2. To help students understand the existential realities including the human existence through Sankhya, Yoga and Vedanta Darshan
3. To help them to see the participation of human beings in the nature/ existential realities (i.e. human values) and therefore the human conduct through each one of them
4. To help students apply this understanding to make their living better at different levels-individual, family, society and nature
5. To facilitate the students in applying this understanding in their profession and lead an ethical life

Course Outcome: On completion of this course, the students will be able to
1. Understand the basic concepts of Sankhya, Yoga and Vedanta Darshan.
2. Understand the human being, the needs and activities of human being through Sankhya, Yoga and Vedanta Darshan.
3. Understand the whole existence
4. Understand the role of human being in the entire existence, thus getting clarity about values at all levels of living and human conduct
5. Understand the foundation of human society and human tradition.

Catalogue Description: Sankhya, Yoga and Vedanta Darshan form a part of the philosophy of Indian tradition. This course outlines the basic concepts and principles of these three philosophies and provides scope for further reading of the philosophies, so as to gain clarity about the human being, the existence and human participation i.e. human values expressing itself in human conduct.
It is to be kept in mind that Darshan means realisation which calls for developing the capacity to see the reality in oneself directly. So, any study of Darshan shall help develop this capacity in the students through proper steps of practices and shall not just provide the information.

Module I :Introduction to Sankhya, Yoga and Vedanta Darshan and their Basics
Need to study Sankhya, Yoga and Vedanta Darshan; the origin of the three philosophies, their basic principles and scope for further reading.

Module II: Sankhya Darshan
Sankhya Darshan- the *nature* of *Purush* and *Prakriti*, 8 types of *prakriti (pradhan, mahattatva ahankar and* five *tanmatras-* sound, touch, form, taste and smell) and their 16 evolutes (*vicar), pramana (pratyaksha, anumana and agama),* bondage and salvation (liberation), the principle of *satkaryavad*, sense organs, work organs, *trigunatmak prakriti*

Module III: YogaDarshan
Yoga Darshan- the steps of *Ashtanga yoga (yama, niyama,aasana, pranayama, pratyahara dharana, dhyan* and *samadhi)* and the challenges in following them, afflictions (*klesha)- avidya asmita, raga, dvesha, abhinivesh,* different types of *vritti (pramana, viparyaya, vikalp, nidra, smriti)* the process of *nirodha* of *vritti; maitri, karuna, mudita, upeksha;* description of *yama, niyama aasana* and *pranayaama; kriyayoga –tapa, swadhyaya* and *ishwar-pranidhana,* different steps of *samadhi,* different types of *sanyama, vivekakhyati, pragya.*

Module IV :Vedanta Darshan Vedanta Darshan- *Nature* of *Brahma* and *Prakriti*, Methods of *Upasana*; a*dhyasa* and s*anskar* n*ature* of Atma, description of existence, principle of *karma-phala*, description of *pancha kosha* different *nature* of *paramatma/brahma, Ishwar, Four qualifications (Sadhan-chatushtay)*.
Module V : Purpose and Program for a Human Being based on the Three Darshan The purpose and program of a human being living on the basis of the three darshanas, clarity and practice of human values and human conduct, the natural outcome of such a program on society nature and tradition. possibility of finding solutions to present day problems in the light of it.
Text Books: 1. Chattejee, S.G. and Datta, D.M., "*An Introduction to Indian Philosophy*", University of Calcutta Press, 1960.
References: 1. Goendaka, J., "*Shreemad Bhagwat Geeta*", Geeta Press, Gorakhpur, 73rd reprint, 2015. 2. Krishna, I., "*The Sankhya Karika*", Bharatiya Vidya Prakashan, 4th edition, 2010. 3. Madhavacharya, "*Sarva-darshan Samgraha*", Chaukhambha Vidya Bhavan, Varanasi, 1984. 4. Maharaj, O. "*Patanjal Yog Pradeep*", Geeta press, Gorakhpur, 30th reprint, 2009. 5. Muller, F.M. "*The Six Systems of Indian Philosophy*", Longmans Green and Co. Publication, London, 1928. 6. Radhakrishnan, S., "*Indian Philosophy* (*Volume* 1 and 2)", Oxford University Press, 2nd edition, 1996. 7. Shankaracharya, "*Vivek Choodamani*", Geeta Press, Gorakhpur, 48th Reprint, 2018. 8. Sivananda, S., "*Raj Yoga*", The Divine Life Society, Rishikesh, 7th edition, 2016. 9. Vachaspati, M., "*Sankhya Tatva Kaumudi*", Motilal Banarasi Das Publication, Varanasi 1921.
Mode of Evaluation: Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

ROE-071 MODELLING AND SIMULATION OF DYNAMIC SYSTEMS

COURSE OBJECTIVE: *Students undergoing this course are expected to-*
1. Define, describe and apply basic concepts related to modeling and simulation.
2. Use conservation laws and constitutive relationships and other physical relations to model mechanical, electrical and flow systems, and combinations of these.

COURSE OUTCOME: *After completion of the course student will be able to-*
CO1: Define, describe and apply basic concepts related to modeling and simulation.
CO2: Construct bond graphs for the type of systems mentioned above, simplify and analyze the bond graph according to causality conflicts.
CO3: Use conservation laws and constitutive relationships and other physical relations to model mechanical, electrical and flow systems.
CO4: Find dynamic response and transfer function using various tools for system modeling.
CO5: Model and simulate mechanical and electrical systems using the computer tools Simulink.

	ROE-071 MODELLING AND SIMULATION OF DYNAMIC SYSTEMS	
Unit	**Topic**	**Lectures**
1	**Introduction to modeling and simulation:** Introduction to modeling, Examples of models, modeling of dynamic system, Introduction to simulation, MATLAB as a simulation tool, Bond graph modeling, causality, generation of system equations.	**8**
2	**Bond graph modeling of dynamic system:** Methods of drawing bond graph model- Mechanical systems & Electrical systems, some basic system models- Mechanical systems, Thermal systems, hydraulic systems, pneumatic systems and electrical systems.	**8**
3	**System models of combined systems:** Linearity and non linearity in systems combined rotary and translatory system, electro mechanical system, hydro-mechanical system.	**8**
4	**Dynamic Response and System Transfer Function:** Dynamic response of 1st order system and 2nd order system, performance measures for 2nd order system, system transfer function, transfer function of 1st and 2nd order system Block diagram algebra, signal flow diagram, state variable formulation, frequency response and bode plots.	**8**
5	**Simulation and simulation applications:** Simulation using SIMULINK, examples of simulation problems- simple and the compound pendulum, planner mechanisms, validation and verification of the simulation model, parameter estimation methods, system identifications, introduction to optimization.	**8**

Text Books and References:
1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2nd Edition. Academic press 2000.
2. Robert L. Woods, Kent L. Lawrence, "Modeling and simulation of dynamic systems", Person, 1997.
3. Brown, Forbes T. "Engineering System Dynamics", New York, NY: CRC, 2001. ISBN: 9780824706166.
4. Pratab.R " Getting started with MATLAB" Oxford university Press 2009.

ROE-072 INTRODUCTION TO SMART GRID

COURSE OBJECTIVE: *Students undergoing this course are expected to-*

1. Present the fundamental concepts associated with Smart Grids.
2. Review renewable energy generation, grid integration energy storage technologies and future developments
3. Introduce advanced management and control concepts of Smart Grids.

COURSE OUTCOME: *After completion of the course student will be able to-*

CO1: Identify the key elements of Smart Grids and visualize the roadmap towards next-Gen electricity networks.

CO2: Evaluate technology options pertaining to renewable energy generation, energy storage, data handling and communications for Smart Grids.

CO3: Justify technological and economical choices in the context of existing commercial Smart Grids projects.

CO4: Determine the relevance of Smart Grids projects, develop ways to evaluate their impacts and implications.

CO5: Analyse the new roles of utilities and consumers in Smart Grids.

	ROE-072 INTRODUCTION TO SMART GRID	
Unit	**Topic**	**Lectures**
1	**Introduction: Introduction to Smart Grid:** Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.	8
2	**Smart Grid Technologies:** Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.	8
3	**Smart Grid Technologies:** Smart Substations, Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU), PMUs application to monitoring & control of power system.	8
4	**Microgrids and Distributed Energy Resources:** Concept of microgrid, need & application of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid, Plastic & Organic solar cells, thin flim solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.	8
5	**Power Quality Management in Smart Grid**: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring.	8

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.
4. Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", Wiley Blackwell 19.
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press.

Reference Books:

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability", Artech House Publishers July 2011.
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
3. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronice and Power Systems)", Springer.
4. R.C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication.
5. Phadke, A.G., Thorp, J.S., "Synchronized Phasor Measurements and Their Applications", Springer.
6. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley.

ROE-073   CLOUD COMPUTING

COURSE OBJECTIVE: *Students undergoing this course are expected to-*

1. Provide students with the fundamentals and essentials of Cloud Computing..
2. Provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.

COURSE OUTCOME: *After completion of the course student will be able to-*

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2: Learn the key and enabling technologies that help in the development of cloud.

CO3: Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models..

CO4: Explain the core issues of cloud computing such as resource management and security.

CO5: To appreciate the emergence of cloud as the next generation computing paradigm.

	ROE-073 CLOUD COMPUTING	
Unit	**Topic**	**Lectures**
1	**Introduction :** Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.	**8**
2	**Cloud Enabling Technologies:** Service Oriented Architecture – REST and Systems of Systems – Web Services Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms–Virtualization of CPU–Memory–I/O Devices–Virtualization Support and Disaster Recovery.	**8**
3	**Cloud Architecture, Services And Storage:** Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage- as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.	**8**
4	**Resource Management And Security In Cloud:** Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a- Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.	**8**
5	**Cloud Technologies And Advancements:** Hadoop – Map Reduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.	**8**

Text and Reference Books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

2. Rittinghouse, John W., and James F. Ransome, ─Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ─Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.

5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

ROE- 074 Understanding the Human Being Comprehensively–Human Aspirations and its Fulfillment

COURSE OBJECTIVE: *Students undergoing this course are expected to-*

1. To help the students having the clarity about human aspirations, goal, activities and purpose of life.

2. To facilitate the competence to understand the harmony in nature/existence and participation of human being in the nature/existence.

3. To help the students to develop the understanding of human tradition and its various components.

COURSE METHODOLOGY:

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.

2. It is free from any dogma or set of do's and don'ts related to values.

3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.

4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.

5. This self-exploration also enables them to critically evaluate their pre- conditionings and present beliefs.

ROE- 074 Understanding the Human Being Comprehensively–Human Aspirations and its Fulfillment		
Unit	**Topic**	**Lectures**
1	**Introduction:** The basic human aspirations and their fulfillment through Right understanding and Resolution; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.	8
2	**Understanding Human being and its expansion:** The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	8
3	**Activities of the Self:** Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Reasons for harmony/contradiction in the self.	8

4	**Understanding Co-existence with other orders:** The need and the process of inner evolution (through self-exploration, self- awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence)	8
5	**Expansion of harmony from self to entire existence:** Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behaviour and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.**.**	8

Reference Books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Sangal, G. P. Bagaria (2010), Excel Books, New Delhi [ISBN 978-8-174-46781-2]
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
3. Economy of Permanence – (a quest for social order based on non-violence), J.C.Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India
4. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA
5. IshandiNauUpnishad, Shankaracharya, Geeta press, Gorakhpur,
6. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
7. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India

8. MahasatipatthanSutta , S N Goenka, Vipassana Research Institute, First Edition, 1996
9. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK
10.Slow is Beautiful, Cecile Andrews http://www.newsociety.com/Books/S/Slow- is-Beautiful)
11.Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
12.Sanchian Sri Guru Granth Sahib Ji ,Shiromani Gurdwara Parbhandhak Committee, 2001
13.SamanSuttam, JinendraVarni ,1974.
14.Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India
15. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.

ROE-075   AUTOMATION AND ROBOTICS

COURSE OBJECTIVE: *Students undergoing this course are expected to-*
1. Acquire the knowledge on advanced algebraic tools for the description of motion.
2. Develop the ability to analyze and design the motion for articulated systems.
3. Develop an ability to use software tools for analysis and design of robotic systems

COURSE OUTCOME: *After completion of the course student will be able to-*
CO1: Use matrix algebra and Lie algebra for computing the kinematics of robot.
CO2: Calculate the forward kinematics and inverse kinematics of serial and parallel robots.
CO3: Calculate the Jacobian for serial and parallel robot.
CO4: Do the path planning for a robotic system.
CO5: Be proficient in the use of Maple or Matlab for the simulation of robots.

<table>
<tr><th colspan="3">ROE-075   AUTOMATION AND ROBOTICS</th></tr>
<tr><th>Unit</th><th>Topic</th><th>Lectures</th></tr>
<tr>
<td>1</td>
<td>Automation: Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.</td>
<td>8</td>
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<tr>
<td>2</td>
<td>Manufacturing Automation: Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimode and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.</td>
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<tr>
<td>3</td>
<td>Robotics: Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source. Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.</td>
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<td>4</td>
<td>Robot Drives and Power Transmission Systems: Robot drive mechanisms: Hydraulic/Electric/Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings. Robot end Effectors: Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for</td>
<td>8</td>
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</table>

	grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.	
5	**Robot Simulation:** Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming. Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.	8

Text Books and References:

1. An Introduction to Robot Technology, by CoifetChirroza, Kogan Page.

2. Robotics for Engineers, by Y. Koren, McGraw Hill.

3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.

4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.

5. Robotics, by J.J. Craig, Addison-Wesley.

6. Industrial Robots, by Groover, McGraw Hill.

7. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.

8. Robots & Manufacturing Automation, by Asfahl, Wiley.

ROE-076 COMPUTERIZED PROCESS CONTROL

COURSE OBJECTIVE: *Students undergoing this course are expected to-*
1. Understand Basics of Computer-Aided Process Control.
2. Analyse Industrial communication System.
3. Design Process Modelling for computerized Process control.
4. Design Advanced Strategies For Computerised Process control.
5. Analyse Computerized Process Control.

COURSE OUTCOME: *After completion of the course student will be able to-*

CO1: Understand the Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer.

CO2: Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system.

CO3: Realize Process model, Physical model, Control Model. Modelling Procedure.

CO4: Formulate of Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.

CO5: Design Electric Oven Temperature Control, Reheat Furnace Temperature control.

ROE-076 COMPUTERIZED PROCESS CONTROL		
Unit	**Topic**	**Lectures**
1	Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer –Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	8
2	Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System	8
3	Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	8
4	Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	8

| 5 | Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant. | 8 |

Text Books:
1. S. K. Singh, "Computer Aided Process control", PHI.

Reference Books:
1. C. L. Smith, "Digital computer Process Control", Ident Educational Publishers.
2. C. D. Johnson, "Process Control Instrumentation Technology", PHI.
3. Krishan Kant, "Computer Based Industrial Control"
4. Pradeep B. Deshpande & Raymond H. Ash, "Element of Computer Process Control with Advance Control Applications", Instrument Society of America, 1981.
5. C. M. Houpis & G. B. Lamond, "Digital Control System Theory", Tata McGraw Hill.

ROE-077 MODELING OF FIELD-EFFECT NANO DEVICES

COURSE OBJECTIVE: *Students undergoing this course are expected to-*
3. Introduce novel MOSFET devices and understand the advantages of multi-gate devices.
4. Introduce the concepts of nanoscale MOS transistor and their performance characteristics.
5. Study the various nano-scaled MOS transistor circuits.

COURSE OUTCOME: *After completion of the course student will be able to-*
CO1: Study the MOS devices used below 10nm and beyond with an eye on the future.
CO2: Understand and study the physics behind the operation of multi-gate systems.
CO3: Design circuits using nano-scaled MOS transistors with the physical insight of their functional characteristics.
CO4: Understand and study the physics behind the Radiation effects in SOI MOSFETs.
CO5: Understand the impact of device performance on digital circuits.

Unit	ROE-077 MODELING OF FIELD-EFFECT NANO DEVICES	
	Topic	**Lectures**
1	MOSFET scaling, short channel effects - channel engineering - source/drain engineering - high k dielectric - copper interconnects - strain engineering, SOI MOSFET, multigate transistors – single gate – double gate – triple gate – surround gate, quantum effects – volume inversion – mobility – threshold voltage – inter subband scattering, multigate technology – mobility – gate stack	**8**
2	MOS Electrostatics – 1D – 2D MOS Electrostatics, MOSFET Current-Voltage Characteristics – CMOS Technology – Ultimate limits, double gate MOS system – gate voltage effect - semiconductor thickness effect – asymmetry effect – oxide thickness effect – electron tunnel current – two dimensional confinement, scattering – mobility	**8**
3	Silicon nanowire MOSFETs – Evaluvation of I-V characteristics – The I-V characteristics for nondegenerate carrier statistics – The I-V characteristics for degenerate carrier statistics – Carbon nanotube – Band structure of carbon nanotube – Band structure of graphene – Physical structure of nanotube – Band structure of nanotube – Carbon nanotube FETs – Carbon nanotube MOSFETs – Schottky barrier carbon nanotube FETs – Electronic conduction in molecules – General model for ballistic nano transistors – MOSFETs with 0D, 1D, and 2D channels – Molecular transistors – Single electron charging – Single electron transistors.	**8**

4	Radiation effects in SOI MOSFETs, total ionizing dose effects – single-gate SOI – multi-gate devices, single event effect, scaling effects	8
5	Digital circuits – impact of device performance on digital circuits – leakage performance trade off – multi VT devices and circuits – SRAM design, analog circuit design – transconductance - intrinsic gain – flicker noise – self heating –band gap voltage reference – operational amplifier – comparator designs, mixed signal – successive approximation DAC, RF circuits.	8

Text and Reference Books:

1. J P Colinge, "FINFETs and other multi-gate transistors", Springer – Series on integrated circuits and systems, 2008
2. Mark Lundstrom, Jing Guo, "Nanoscale Transistors: Device Physics, Modeling and Simulation", Springer, 2006
3. M S Lundstorm, "Fundamentals of Carrier Transport", 2nd Ed., Cambridge University Press, Cambridge UK, 2000.

ROE-078   QUALITY MANAGEMENT

COURSE OBJECTIVE: *Students undergoing this course are expected to-*
1. Introduce the importance of quality in improving competitiveness.
2. Understand the Implication of Quality on Business.
3. Implement Quality Implementation Programs.
4. Have exposure to challenges in Quality Improvement Programs.

COURSE OUTCOME: *After completion of the course student will be able to-*

CO1: Realize the importance of significance of quality.

CO2: Manage quality improvement teams.

CO3: Identify requirements of quality improvement programs.

CO4: Identify improvement areas based on cost of poor quality.

CO5: Organize for quality and development of quality culture through small group activities.

	ROE-078 QUALITY MANAGEMENT	
Unit	**Topic**	**Lectures**
1	Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.	8
2	Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.	8
3	Control Charts, Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.	8
4	Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test	8

	results, reliability control, maintainability, zero defects, quality circle.	
5	ISO-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details.	**8**

Text and Reference Books:
1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.
2. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.
   Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992

ROE-079 GIS & REMOTE SENSING

COURSE OBJECTIVE: *Students undergoing this course are expected to-*

1. Understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

COURSE OUTCOME: *After completion of the course student will be able to-*

CO1: Understand about the principles of Remote Sensing and its advantages and limitations.
CO2: Retrieve the information content of remotely sensed data.
CO3: Apply problem specific remote sensing data for engineering applications.
CO4: Analyze spatial and attribute data for solving spatial problems.
CO5: Create GIS and cartographic outputs for presentation

Unit	Topic	Lectures
	ROE-079 GIS & REMOTE SENSING	
1	Basic component of remote sensing (RS), advantages and limitations of RS, possible use of RS techniques in assessment and monitoring of land and water resources; electromagnetic spectrum, energy interactions in the atmosphere and with the Earth's surface; major atmospheric windows; principal applications of different wavelength regions; typical spectral reflectance curve for vegetation, soil and water, spectral signatures.	8
2	Different types of sensors and platforms; contrast ratio and possible causes of low contrast; aerial photography; types of aerial photographs, scale of aerial photographs, planning aerial photography- end lap and side lap; stereoscopic vision, requirements of stereoscopic photographs; air-photo interpretation- interpretation elements;	8
3	photogrammetry- measurements on a single vertical aerial photograph, measurements on a stereo-pair- vertical measurements by the parallax method; ground control for aerial photography; satellite remote sensing, multispectral scanner- whiskbroom and push-broom scanner; different types of resolutions; analysis of digital data- image restoration; image enhancement; information extraction, image classification, unsupervised classification, supervised classification, important consideration in the identification of training areas, vegetation indices.	8
4	Microwave remote sensing. GI Sand basic components, different sources of spatial data, basic spatial entities, major components of spatial data, Basic classes of map projections and their properties. .	8
5	Methods of data input into GIS, Data editing, spatial data models and structures, Attribute data management, integrating data (map overlay) in GIS, Application of remote sensing and GIS for the management of land and water resources.	8

Text & Reference Books:

1. Reddy Anji, M. 2006. Textbook of Remote Sensing and Geographical Information Systems. BS Publications, Hyderabad.
2. Elangovan, K. 2006. GIS Fundamentals Applications and Implementations. New India Publication Agency, New Delhi.
3. George Joseph. 2005. Fundamentals of Remote Sensing. 2nd Edition. Universities Press (India) Private Limited, Hyderabad.
4. Jensen, J.R. 2013. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson Education Limited, UK.
5. Lillesand, T., R.W. Kiefer and J. Chipman. 2015. Remote Sensing and Image Interpretation. 7th Edition, John Wiley and Sons Singapore Pvt. Ltd., Singapore.
6. Sabins, F.F. 2007. Remote Sensing: Principles and Interpretation. Third Edition, Waveland Press Inc., Illinois, USA.

ROE 080	**Human Values in Bauddha and Jain Darshan**	**L**	**T**	**P**	**C**
		3	0	0	3
Version No.:	2.0 (updated as on June 12th 2019)				
Prerequisite:	RVE 301/401- Universal Human Values and Professional Ethics Desirable- 10 Day Vipassana Meditation course by Shri S. N. Goenka				

Objectives:
1. To help students understand the basic principles of Bauddha and Jain Darshan
2. To help students understand the existential realities including the human existence through Bauddha and Jain Darshan
3. To help them to see the participation of human beings in the nature/ existential realities (i.e. human values) and therefore the human conduct through each one of them
4. To help students apply this understanding to make their living better at different levels- individual, family, society and nature
5. To facilitate the students in applying this understanding in their profession and lead an ethical life.

Course Outcome: On completion of this course, the students will be able to
1. Understand the basic concepts of Bauddha and Jain Darshan
2. Understand the human being, the needs and activities of human being through Bauddha and Jain Darshan
3. Understand the whole existence
4. Understand the role of human being in the entire existence, thus getting clarity about values at all levels of living and human conduct
5. Understand the foundation of human society and human tradition.

Catalogue Description: Bauddha and Jain Darshan form a part of the philosophy of Indian tradition. This course outlines the basic concepts and principles of these two philosophies and provides scope for further reading of the philosophies, so as to gain clarity about the human being, the existence and human participation i.e. human values expressing itself in human conduct.
It is to be kept in mind that Darshan means realisation which calls for developing the capacity to see the reality in oneself directly. So, any study of Darshan shall help develop this capacity in the students through proper steps of practices and shall not just provide the information.

Module I: Introduction to Bauddha and Jain Darshan and their Basics
Need to study Bauddha and Jain Darshan; the origin of the thsee philosophies, their basic principles and scope for further reading.

Module II: Basic Principles of Bauddha Darshan
law of impermanence (changability); four noble truths; eightfold path; law of cause- action (*pratitya-samutpaad*)
Definition of some salient words of Buddha Darshan – *nirvana, dhamma, tri- ratna(Buddha, Dharma and Sangh), pragya, karma, parmi, ashta-kalap, trishna, shad-ayatan, samvedana, vipassana, anitya, maitri, brham-vihaar, tathagata, arahant.*

Module III: Purpose and Program for a Human Being based on Bauddha Darshan
The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition.
Purpose-freedom from suffering, *nirvana*; root of suffering- *vikaar – raga, dvesha* and *moha,* Progam – various steps of meditation for attaining knowledge; *shamath and vipassana; sheel-samadhi-pragya; practice of equanimity (samatva),* eightfold path(Ashtang Marg); combination of understanding and practice.

Module IV: Basic Principles of Jain Darshan

Basic realities – description of nine elements in existence (*jeev, ajeev, bandh, punya, paap, aashrav, samvar, nirjara, moksha*), 6 dravya of lok – *dharma, adhrma, akash, kaal, pudgal, jeev*; tri-lakshan, various types of *pragya*, various stages of realisation; *samyak-gyan, samyak-darshan, samyak-charitra, syadvaad, anekantavaad, naya- nishchaya and vyavahar, karma-phal siddhanta*

Definition of some salient words of Jain Darshan –*arhant, jin, tirthankara, panch-parameshthi, atma, pramaan, kaal, pudgal, paramanu, kashay, leshya.*

Module V: Purpose and Program for a Human Being based on Jain Darshan

The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition, possibility of finding solutions to present day problems in the light of it.

Purpose (goal) - *moksha*, Program- following *mahavrat, anuvrat, 10 lakshan dharma; samyak darshan-gyan-charitra.* Commonality with Bauddha Darshan

Text Books:
1. Chattejee, S.G. and Datta, D.M., "*An Introduction to Indian Philosophy*", University of Calcutta Press, 1960.

References:
1. "*Dhammapad*", Vipassana Research Institute, 2001.
2. Drukpa, G., "*Musings from the Heart*", Drukpa Publications Private Ltd, 2018.
3. Jyot, *"Ek cheez milegi Wonderful"*, A Film Directed by Jyot Foundation, 2013.
4. Goenka, S.N., "The Discourse Summaries", Vipassana Research Institute, 1987.
5. Madhavacharya, "*Sarva-darshan Samgraha*", Chaukhambha Vidya Bhavan, Varanasi, 1984.
6. Varni, J., "*Samansuttam*", Sarva Seva Sangh Prakashan, Varanasi, 7th Edition, 2010.
7. https://www.youtube.com/watch?v=cz7QHNvNFfA&list=PLPJVlVRVmhc4Z01fD57j bzycm9I6W054x (English)
8. https://www.youtube.com/watch?v=r5bud1ybBDc&list=PLY9hraHvoLQLCkl7Z2DW KMgRAWU77bKFy (Hindi)

Mode of Evaluation: Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

Open Electives for B.Tech 4th year (CBCS)		
Open Electives I (VII Semester)		
Sl. No.	Subject Code	Name of Elective(s)
1	ROE071	Modelling and Simulation of Dynamic Systems
2	ROE072	Introduction to Smart Grid
3	ROE073	Cloud computing
4	ROE074	Understanding the human being Comprehensively Human Aspiration audits fulfilment
Open Electives II (VIII Semester)		
Sl. No.	Subject Code	Name of Elective(s)
1	ROE081	Digital and Social Media Marketing
2	ROE082	Entrepreneurship Development
3	ROE083	Machine Learning
4	ROE084	Micro and Smart Systems
5	ROE085	Operations Research
6	ROE086	Renewable Energy Resources
7	ROE087	*Human Values in Madhyasth Darshan
8	ROE088	*Values, Relationship & Ethical Human Conduct-For a Happy & Harmonious Society

Note:

1. The Student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the degree programme.
2. * It is mandatory that for these two subjects (ROE087 & ROE088) only trained Faculty (who had done the FDP for these courses) will teach the courses.

ROE081	DIGITAL AND SOCIAL MEDIA MARKETING	L T P 3 0 0

UNIT-I	Introduction to Digital Marketing: The new digital world - trends that are driving shifts from traditional marketing practices to digital marketing practices, the modern digital consumer and new consumer's digital journey. Marketing strategies for the digital world-latest practices.
UNIT-II	Social Media Marketing -Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post, Content Planning and writing. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns
UNIT-III	Acquiring & Engaging Users through Digital Channels: Understanding the relationship between content and branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing. Marketing gamification, Online campaign management; using marketing analytic tools to segment, target and position; overview of search engine optimization (SEO).
UNIT-IV	Designing Organization for Digital Success: Digital transformation, digital leadership principles, online P.R. and reputation management. ROI of digital strategies, how digital marketing is adding value to business, and evaluating cost effectiveness of digital strategies
UNIT-V	Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing Understanding trends in digital marketing – Indian and global context, online communities and co-creation,

Text books:

1. Moutsy Maiti: Internet Mareting, Oxford University Press India

2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).

3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional (October, 2013).

4. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page (3rd Edition, 2014).

5. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

ROE082   ENTREPRENEURSHIP DEVELOPMENT   L T P 3 0 0

UNIT-I	Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.
UNIT-II	Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.
UNIT-III	Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.
UNIT-IV	Project Planning and control: The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.
UNIT-V	Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

Text books:

1. Forbat, John, "Entrepreneurship" New Age International.

2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International

3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India

ROE083   MACHINE LEARNING   L T P 3 0 0

UNIT-I
INTRODUCTION – Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias

UNIT-II
DECISION TREE LEARNING - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning; ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule Backpropagation AlgorithmConvergence, Generalization;

UNIT-III
Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm;

UNIT-IV
Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning

UNIT-V
Genetic Algorithms: an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules-sequential covering algorithms-General to specific beam search-FOIL; REINFORCEMENT LEARNING - The Learning Task, Q Learning.

Text books:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and
Machine Learning), The MIT Press 2004.

3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.

| ROE084 | MICRO AND SMART SYSTEMS | L T P 3 0 0 |

UNIT-I Introduction, Why miniaturization?, Microsystems versus MEMS, Why micro fabrication?, smart materials, structures and systems, integrated Microsystems, applications of smart materials and Microsystems.

UNIT-II Micro sensors, actuators, systems and smart materials: Silicon capacitive accelerometer, piezoresistive pressure sensor, conductometric gas sensor, an electrostatic combo-drive, a magnetic microrelay, portable blood analyzer, piezoelectric inkjet print head, micromirror array for video projection, smart materials and systems.

UNIT-III Micromachining technologies: silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining, specialized materials for Microsystems, advanced processes for micro fabrication.

UNIT-IV Modeling of solids in Microsystems: Bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams, torsion of beams and shear stresses, dealing with large displacements, In-plane stresses, Modelling of coupled electromechanical systems: electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics. Squeezed film effects in electromechanics.

UNIT-V Integration of micro and smart systems: integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems, case study of a smart-structure in vibration control. Scaling effects in Microsystems: scaling in: mechanical domain, electrostatic domain, magnetic domain, diffusion, effects in the optical domain, biochemical phenomena.

Text books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, "Micro and smart systems", Wiley India, 2010.

ROE085   OPERATIONS RESEARACH   L T P 3 0 0

UNIT-I
Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.

UNIT-II
Transportation Problems: Types of transportation problems, mathematical models , transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.

UNIT-III
Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT.

UNIT-IV
Theory of Games : Rectangular games, Minimax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models.

UNIT-V
Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipments that deteriorate with time, equipments that fail with time.

Text books:

1. Wayne L. Winston,"Operations Research" Thomson Learning, 2003.

2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education, 2003.

3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.

4. V.K.Khanna, "Total Quality Management" New Age International, 2008.

ROE086: RENEWABLE ENERGY RESOURCES   L T P 3 0 0

UNIT-I
Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT-II
Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT-III
Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV
Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.

UNIT-V
Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Text books:

1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle," Renewable Energy Power For A Sustainable Future", Oxford University Press.

ROE 087	Human Values in Madhyasth Darshan	L	T	P	C
		3	0	0	3

Version No.:	2.0 (updated as on June 12th 2019

Version No.:	2.0 (updated as on June 12th 2019
Prerequisite:	RVE 301/401- Universal Human Values and Professional Ethics

Objectives:
1. To help students understand the basic principles of Madhyasth Darshan
2. To help students understand the existential realities including the human existence through Madhyasth Darshan
3. To help them to see the participation of human beings in the nature/ existential realities (i.e. human values) and therefore the human conduct through each one of them
4. To help students apply this understanding to make their living better at different levels- individual, family, society and nature
5. To facilitate the students in applying this understanding in their profession and lead an ethical life

Course Outcome: On completion of this course, the students will be able to
1. Understand the basic concepts of Madhyasth Darshan
2. Understand the human being, the needs and activities of human being through Madhyasth Darshan
3. Understand the whole existence
4. Understand the role of human being in the entire existence, thus getting clarity about values at all levels of living and human conduct
5. Understand the foundation of human society and human tradition.

Catalogue Description: Madhyasth Darshan is a new emerging philosophy that describes the existential realities along with its implication in behaviour and work at the level of individual as well as society. This philosophy has been propounded by Shri A. Nagraj in seventies.
It is to be kept in mind that Darshan means realisation which calls for developing the capacity to see the reality in oneself directly. So, any study of Darshan shall help develop this capacity in the students through proper steps of practices and shall not just provide the information.

Module I: Introduction to Madhyasth Darshan and its Basics
Need to study Madhyasth Darshan; introduction, basic formulations of the darshan; the complete expanse of study and the natural outcome of living according to the darshan.

Module II: Submergence of Nature in Space
The ever-present existence in the form of nature submerged in space; nature classified into two categories – material and consciousness, and four orders; the form, property, natural characteristic and self-organization of the four orders, General direction and process of evolution in the nature/ existence.

Module III: Human Being as an indivisible part of Nature
Human being as an indivisible part of nature; various types (five classes) of human beings; human being in the combination of self and body; purpose of self as realization, prosperity for the body; need of behavior and work for attaining the goals of realization and prosperity.

Module IV: Fulfillment of human goal of realization and prosperity
Following natural, social and psychological principles for actualizing the human goal; form of conducive society and order for such practices, study process- achieving realization through self-study and practice while living in such a society (social order).

Module V: Human Conduct based on Madhyasth Darshan
Description of such a realized self, continuity of happiness, peace, satisfaction and bliss through realization, conduct of a realized human being.
Possibility of finding solutions to present day problems (such as inequality of rich and poor, man and woman etc.) in the light of it.

Text Books:
  1. Nagraj, A., "*Manav Vyavahar Darshan*", Jeevan Vidya Prakashan, 3rd edition, 2003.

References:
  1. Nagraj, A., "*Vyavaharvadi Samajshastra*", Jeevan Vidya Prakashan, 2nd edition, 2009.
  2. Nagraj, A., "*Avartanasheel Arthashastra*", Jeevan Vidya Prakashan, 1st edition, 1998.

Mode of Evaluation: Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

ROE088   VALUES,   RELATIONSHIP & ETHICAL HUMAN   CONDUCT–FOR   A
        HAPPY & HARMONIOUS   SOCIETY   L T P 3 0 0

Pre-requisites- for this subject only those faculty will teach these courses who had done
        the FDP for these courses.

Course Objectives:
    1.   To help the students to understand the importance and types of relationship
          with expressions.
    2.   To develop the competence to think about the conceptual framework of
          undivided society as well as universal human order.
    3.   To help the students to develop the exposure for transition from current state
          to the undivided society and universal human order.
 Course Methodology:
    1. The methodology of this course is explorational and thus universally adaptable. It
        involves a systematic and rational study of the human being vis-à-vis the rest of
        existence.
    2. It is free from any dogma or set of do's and don'ts related to values.
    3. It is a process of self-investigation and self-exploration, and not of giving
        sermons. Whatever is found as truth or reality is stated as a proposal and the
        students are facilitated and encouraged to verify it in their own right, based on
        their Natural Acceptance and subsequent Experiential Validation.
    4. This process of self-exploration takes the form of a dialogue between the teacher
        and the students to begin with, and then to continue within the student leading to
        continuous self-evolution.
    5. This self-exploration also enables them to critically evaluate their pre-
        conditionings and present beliefs.

UNIT-I	Introduction to the course: Basic aspiration of a Human Being and program for its fulfillment, Need for family and relationship for a Human Being, Human-human relationship and role of behavior in its fulfillment, Human-rest of Nature relationship and role of work in its fulfillment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of the Current State, Appraisal of Efforts in this Direction in Human History.
UNIT-II	Understanding Human-Human Relationship & its fulfillment: Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfillment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.
UNIT-III	Justice from family to world family order: Undivided Society as continuity and expanse of Justice in behavior – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.

UNIT-IV	Program for Ensuring Undivided Society and Universal Human Order: Education – Sanskar, Health – Sanyam, Production-work, Exchange – storage, Justice-preservation.
UNIT-V	Human Tradition: Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.

Text books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2010), Excel Books, New Delhi.
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
3. An Appeal by the Dalai Lama to the World: Ethics Are More Important Than Religion , Dalai Lama XIV, 2015.
4. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India.
5. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA.
6. Human Society, Kingsley Davis, 1949.
7. Hind Swaraj or, Indian home rule Mohandas K. Gandhi, 1909.
8. Integral Humanism, Deendayal Upadhyaya, 1965.
9. Lohiya Ke Vichar, Lok Bharti , Rammanohar Lohiya, 2008.
10. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
11. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
12. Samadhanatmak Bhautikvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India
13. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher, 1973, Blond & Briggs, UK.
14. Slow is Beautiful, Cecile Andrews (http://www.newsociety.com/Books/S/Slow-is-Beautiful)
15. Sociology Themes and Perspectives, Harper Collins; EIGHT edition (2014), Martin Holborn and Peter Langley, 1980.
16. Samagra kranti: Jaya Prakash Narayan's philosophy of social change, Siddharth Publications Renu Sinha, 1996.
17. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
18. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
19. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
20. The Communist Manifesto, Karl Marx, 1848.
21. Toward a True Kinship of Faiths: How the World's Religions Can Come Together Dalai Lama XIV, 2011.

Reference Videos.

1. kin school (30 minutes)
2. Technology (Solar City etc.).
3. Natural Farming.
4. Economics of Happiness (1h 8m)