।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील अभियांत्रीकीच्या पदवी स्तरावरील अंतीम वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, मा. विद्याशाखेने **दिनांक ३१ मे २०२१ रोजीच्या बैठकीतील केलेल्या शिफारशीप्रमाणे व दिनांक १२ जून २०२१ रोजी संपन्न झालेल्या ५१ व्या मा. विद्या परिषद बैठकीतील विषय क्र. २६/५१–२०२१**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील अभियांत्रीकीच्या पदवी स्तरावरील अंतीम वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२१–२२ पासून लागू करण्यात येत आहेत.

B. E. final year - Electrical Engineering

B. E. final year - Computer Engineeing

B. E. final year - Mechanical Engineering

B. E. final year - Civil Engineering

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.

जा.क्र.: शैक्षणिक–१/परिपत्रक/पदवी–सीबीसीएस अभ्यासक्रम/२०२१–२२/८९

दिनांक : २४.०७.२०२१.

स्वाक्षरित
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.
७) अधीक्षक, परिक्षा विभाग विज्ञान व तंत्रज्ञान विद्याशाखा प्रस्तुत विद्यापीठ.

CURRICULUM

For

UNDERGRADUATE DEGREE COURSES IN

ELECTRICAL ENGINEERING

(Engineering & Technology)

[Proposed from 2021-22]

For

Swami Ramanand Thirth Marathwada University Nanded

Teaching Scheme - Final Year Electrical Engineering

SEMESTER – VII

SI. No.	Category	Code	Course Title	Hours per Week				Marking Scheme					Theory Total
				L	T	P	CR	PR	OR	TW	MSE	ESE	
1.	Professional Elective Courses	PEC-EE701(A)	Elective-IV (Electrical Energy Conservation &Auditing)	3	0	2	4	-	25#	25	30	70	150
		PEC-EE701(B)	Elective-IV (Modern Electric Traction)										
2.	Professional Elective Courses	PEC-EE702(A)	Elective –V (Wind & Solar Energy system)	3	0	2	4	-	25#	25	30	70	150
		PEC-EE702(B)	Elective –V (Illumination Engineering)										
3.	Open Elective Courses	OEC-EE703(A)	Open Elective –III (Electrical Installation, Testing & Maintenance)	3	0	2	4	25#	-	25	15	35	100
		OEC-EE703(B)	Open Elective –III (Microcontroller Application in Electrical Engineering)										
4.	Open Elective Courses	OEC-EE704(A)	Open Elective –IV(Advanced Power Electronics)	2	0	2	3	25@	-	25	15	35	100
		OEC-EE704(B)	Open Elective –IV (Embedded system)										
5.	Project	PROJEE-705	Project-I(Project work, Seminar and Internship in industry or at appropriate work place)	0	0	10	5	--	50@	50	-	-	100
6	Mandatory	MC 706	Industry Internship	0	0	0	0	-	25#	25			50
7.	Humanities and Social Sciences including Management Courses	HSMC707	Interview Techniques and Mock Exercise	0	0	2	1	-	25@	25	-	-	50
Total				**11**	**0**	**20**	**21**	**50**	**150**	**200**	**90**	**210**	**700**

Symbols to remember: -@ - Internal Assessment, # - External Assessment T – Theory , P– Practical, T – Tutorial , CR – Credit , OR – Oral , TW – Term work, MSE – Minor Semester Examination, ESE – End Semester Examination.

Teaching Scheme - Final Year Electrical Engineering

SEMESTER – VIII

SI. No.	Category	Code	Course Title	Hours per Week				Marking Scheme					Theory Total
				L	T	P	CR	PR	OR	TW	MSE	ESE	
1.	Professional Elective Courses	PEC –EE 801(A)	Elective-VI (Power Quality & FACTS)	3	0	2	4	25@	-	25	30	70	150
		PEC –EE 801(B)	Elective-VI (VLSI Circuit)										
2.	Open Elective Courses	OEC-EE802(A)	Open Elective-V (Electrical & Hybrid Vehicles)	3	0	2	4	25@	-	25	30	70	150
		OEC-EE802(B)	Open Elective-V (Digital Signal Processing)										
3.	Open Elective Courses	OEC-EE803(A)	Open Elective-VI (Electrical System Planning & Designing)	3	0	2	4	25@	-	25	30	70	150
		OEC-EE803(B)	Open Elective-VI (Electromagnetic Waves)										
4.	Project	PROJ-EE 804	Project-II(Continued from VII Semester, Final Project work, Testing, Result, Conclusion & future scope , Seminar, and Prepare a paper for conference Presentation/ Publication in Journal)	0	0	10	5	----	150#	50	-	-	200
5	Humanities and Social Sciences including Management Courses	HSMC 805	Entrepreneurship Development	0	0	2	1	-	25@	25	0	0	50
Total				**9**	**0**	**18**	**18**	**75**	**175**	**150**	**90**	**210**	**700**

Symbols to remember: -@ - Internal Assessment, # - External Assessment T – Theory , P– Practical, T – Tutorial , CR – Credit , OR – Oral , TW – Term work, MSE – Minor Semester Examination, ESE – End Semester Examination.

Swami Ramanand Teerth Marathwada University, Nanded

B.E Final Year in Electrical Engineering & Electical, Electronics and Power (Revised Syllabus, CGPA Revised) Effective from 2021-22

PEC-EE 701(A) Elective IV Electrical Energy Conservation & Auditing

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Professional Elective Courses	PEC-EE701(A)	Elective-IV (Electrical Energy Conservation &Auditing)	3	0	2	4	-	25#	25	30	70	150

Course Objective:

1. To understand energy conservation and its importance.
2. To find requirement of energy auditor and energy manager.
3. To understand features of energy conservation act.
4. To enhance energy efficiency in electrical system by using different techniques.

Module 1: Energy Scenario (6 Hrs)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Module 2: Basics of Energy and its various forms (6 Hrs)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Module 3: Energy Management & Audit (8 Hrs)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Module 4: Energy Efficiency in Electrical Systems (6 Hrs)

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Module 5: Energy Efficiency in Industrial Systems (8 Hrs)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Module 6: Energy Efficient Technologies in Electrical Systems (6 Hrs)

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Find the current energy scenario and importance of energy conservation.
- Aply the concepts of energy management.

- Aply the methods of improving energy efficiency in different electrical systems.
- Use different energy efficient devices.

Reference Books

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)

2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.

4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

List of Practical's:

1. List various energy management systems prevailing in a particular industry/Organization
2. Identify the energy management skills and strategies in the energy management system
3. Organize an energy management program in a given industry
4. List the various energy conservation methods useful in a particular industry
5. Identify the critical areas where energy conservation is required
6. Select appropriate energy conservation method for the critical area identified
7. List the various energy conservation methods useful in power generation, transmission and distribution
8. Find out the payback period for a given energy conservation equipment
9. Determine depreciation cost of a given energy conservation project/equipment
10. Draw the energy flow diagram for a industry/shop floor division
11. Identify various measuring instruments used for energy audit
12. Use various measuring instruments for carrying out energy audit
13. Prepare a sample energy audit questionnaire
14. Prepare an energy audit report
15. Prepare a technical report on energy conservation act 2003

Suggested list of student activities:

Following is the list of proposed student activities:

1. Assignments on solving simple numerical.

2. Prepare a report based on a survey of at least two nearby industries on energy conservation measures Adopted by them using questionnaire.

3. Carry out a survey on internet and prepare a report on energy conservation act an ECBC.

4. Carry out detailed energy audit of your Institute or any other official building.

PEC –EE-701(B) Elective-IV (Modern Electric Traction)

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Professional Elective Courses	PEC-EE701(B)	Elective-IV (Modern Electric Traction)	3	0	2	4	-	25#	25	30	70	150

Course Objective:

1. To prepare student for analysis of any traction system.
2. To know the principles of Electric traction motor and their control.
3. To expose student to the concept of railway signaling.

Module 1: Electric Traction- Principle and History (6 Hrs)

Systems of traction, Indian Scenario, Electric traction State of art, Electric traction as a Viable Transport Strategy for the 21st century, Advantages of Electric Traction over other systems of traction, Choice of traction system - Diesel- Electric or Electric.

Module 2: Mechanics of train movement (6 Hrs)

Speed - time curve for train movement, Requirement of tractive effort and T-N curve of a typical train load, Specific energy consumption & Factors affecting SEC.

Module 3: Adhesion, types of suspension and mechanism of torque transmission (6 Hrs)

Adhesion & Coefficient of adhesion, Suspension and mechanism of torque transmission,

Concept of Weight Transfer and Effect of unsprung mass and wheel diameter.

Module 4: Traction Motor (6 Hrs)

Type of traction motor best suited for traction duties, available motor characteristics and their suitability for traction duties, optimization of design and construction features for improved power to weight ratio.

Module 5: Electric Traction Sub-Systems (Overhead Equipment): (4 Hrs)

Overhead Equipment (OHE), Sectionalizing, Bonding of Rails and Masts, Materials Employed in OHE.

Module 6: Railway Signaling: (8 Hrs)

Block Section Concept, Track Circuits, Interlocking Principle, Train speed and signaling, Solid state, Interlocking, automatic Warning Systems, CAB signaling, Signaling level crossing. Electric Traction Sub-Systems (Power Supply Installations)-Lay out design of 137/25 KV 18Traction Substation/ Protection, booster Transformers and Return Conductor, Salient 2x25 kv AC System/ SCADA.

Course outcome:-

- Identify and describe the use of components of power supply arrangements for electric
- Traction.
- Know different overhead equipment's
- Compare the different type of current collecting systems and current collecting gears
- Explain various types of signals and track circuits
- Describe supervisory control used in electric traction
- Know special requirements of train lighting system
- Understand the importance of electric locomotive maintenance and protective system
- Describe the recent trends in electric traction- LEM propelled traction, Metro Rail,

Reference Books:

1. Upadhayay J. & Mahindra S.N, "Electric Traction", Allied Publishers Ltd., 1st Ed.

2. Rao P.S, "Principle of 25 KV Overhead Equipments" R.(Nasik) Printpack Pvt Ltd,, 1st Ed,

3. Gopal K Dubey,"Fundamentals of Electric Drives" , Narosa Publishing.

4. Partab, "Modern Electric Traction" , Dhanpat Rai & Sons

List of Practical (Drawing Assignments)

1. Traction Substation and Feeding Post Layout.
2. Overhead equipment's (OHE) and Current Collecting equipment's.
   (At least 6 equipment on 2 sheets)
3. Signaling and Train Lighting.
4. Power Circuit in Electric Locomotive and Auxiliary Circuit equipment's.
5. Study of energy recovered using regenerative braking.
6. Solve numerical on speed time curve.
7. Study of various traction systems.
8. Study of train lighting system.
9. Study of power diagram of AC locomotive and its equipment.
10. Draw sketch of the current collecting equipment

PEC-EE-702(A) Wind & Solar Energy System

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Professional Elective Courses	PEC-EE702(A)	Elective – V (Wind & Solar Energy system)	3	0	2	4	-	25#	25	30	70	150

Course Objectives :

1. To create awareness about the importance of renewable technology for sustainable future.
2. Impart the knowledge of solar power generation and wind power generation
3. To acquaint students with possible storage systems in renewable generation.
4. Introduce recent trends in renewable energy system to students

Module 1: Physics of Wind Power (6 Hrs)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module 2: Wind generator topologies (8 Hrs)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Module 3: The Solar Resource (6 Hrs)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module 4: Solar photovoltaic (8 Hrs)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Module 5: Network Integration Issues (8 Hrs)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Module 6: Solar thermal power generation (4 Hrs)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the energy scenario and the consequent growth of the power generation from
- Renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

Reference Books

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

2. G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons, 2004.

3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.

4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.

5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.

6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

List of experiments

1. To identify and measure the parameters of a Solar PV Module with Series and/or Parallel combination.

2. To plot I-V and P-V characteristics with series and parallel combination of Solar PV Modules for different Insolation and temperature effects.

3. To evaluate effect of Shading and Tilt Angle on I-V and PV characteristics of Solar Module.

4. To estimate effect of sun tracking on energy generation by Solar PV Module.

5. To estimate efficiency of standalone Solar PV Module.

6. To evaluate performance of solar flat plate collector.

7. To plot characteristics of lead-acid battery for various source and load condition.

8. To analyze effect of blade angles on performance of wind turbine.

9. To evaluate performance of horizontal axis wind turbine.

10. To evaluate performance evolution of vertical axis wind turbine. s

11. To study synchronization of wind electric generator.

12. Wind generation analysis using Matlab for variable wind speeds.

13. Field visit to Renewable Energy Sources locations or Manufacturing Industry.

14. To evaluate efficiency of DFIG System (Hardware setup only).

EC-EE-702(B) Illumination Engineering

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Professional Elective Courses	PEC-EE702(B)	Elective –V (Illumination Engineering)	3	0	2	4	-	25#	25	30	70	150

Course Objectives:

1. To provide introduction to illumination system.
2. To find importance of illumination in human life.
3. To apply various light source as per application.

Module 1: Importance of Lighting in Human Life **(6 Hrs)**

Optical systems of human eye ,Dependence of human activities on light, performance characteristics of human visual system, External factors of vision-visual acuity, contrast ,sensitivity, time illuminance, color, visual perception, optical radiation hazards, Good and bad effects of lighting & perfect level of illumination, Artificial lighting as substitute to natural light, Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification & Measurement of Light.

Module 2: Light Source **(8 Hrs)**

Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non-metals. Discharge Lamps: Theory of gas Discharge phenomena, lamp design considerations, characteristics of low and high mercury and sodium vapor lamps, Low Vapor Pressure discharge lamps - Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL), High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps, Electro luminescent lamps, LEDs characteristics, features and applications, LASERS, characteristics, features and applications, non-lighting lamps, Induction lamps. Optical fiber, its construction as a light guide, features and applications

Module 3: Electrical Control of Light Sources **(8 Hrs)**

Ballast and ignitors for different HID lamps, design considerations of Electromagnetic and Electronic ballast for TL and HID lamps, Ballast material, Dimming. Photometric Control of Light Sources and their Quantification: Luminaries design considerations, optical control schemes, design procedure of reflecting and refracting type of luminaries. Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, types of lighting fixtures according to installation type, types of lighting fixtures according to photometric usages, ingress protection code, luminaries standard. Indian standard recommendations.

Module 4: Factors of Good Lighting Design **(6 Hrs)**

Indoor Lighting Design: Zonal cavity method for general lighting design, coefficient of utilization determination for zonal cavities and different shaped ceilings. Using COU (coefficient of utilization), using beam angles and polar diagrams, glare calculations. Typical applications: office, educational facility, theatre, residential, hospital. Indian Standard recommendation for indoor lighting, selection criteria for selection of lamps and luminaries, design consideration and design procedure. (problems on COV, beam angles and polar diagrams).

Module 5: Outdoor Lighting Design **(6 Hrs)**

Road classifications according to BIS, pole arrangement, terminology, lamp and luminaire selection, different design procedures, beam lumen method, point by point method, isolux diagram, problems on point by point method. Energy Efficient Lighting: Comparison between different light sources, comparison between different control gears, overcoming problems in energy efficient lighting, payback calculation, life cycle costing, (problems on payback calculations, life cycle costing). 11

Module 6: Solar Lighting **(6 Hrs)**

Day Lighting, Photovoltaic Lighting Emergency Lighting: Central Systems, Stand alone systems Cold Lighting: Concept, Method of generation – Optical Fiber cable (OFC), filters, Application Switching Control for Lighting Typical Lighting Project Design: New projects, Retrofits

Course Outcomes:

- Understand the meaning of the terms used in illumination engineering.
- Realize the requirements of various types of consumers.
- Study requirements of illumination levels for various applications.
- Understand the requirements of illumination equipment and accessories for different applications
- To provide an introduction to the fundamentals of illumination engineering and architectural lighting design.
- To impart lighting fundamentals, measurement, and technology and their application in the analysis and design of architectural lighting systems.

Reference Books:

1. "BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting", Manak Bhavan, New Delhi
2. D. C. Pritchard, "Lighting", 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0

3. Elmer, "Design of Reflectors"

4. "IES Lighting Handbook", (Reference Volume 1984), Illuminating Engineering Society of North America

5. "IES Lighting Handbook", (Application Volume 1987), Illuminating Engineering Society of North America

List of Practical's:-

1. Study of Construction and function of each component of road/flood light etc. luminaries.
2. To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of an incandescent lamp and compare with the theoretical curves.
3. To study the effect of reflectors on luminaire intensity distribution.
4. To determine luminous efficiency of a luminaire.
5. To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of a road lighting luminaire and compare with the theoretical curves.
6. To determine utilization factor of a luminaire.
7. To study Goniometer for A-α, B-β, C-γ, co-ordinate system of measurement.

8. To plot the candlepower, power consumed, current drawn v/s voltage characteristic curve of a flood lighting luminaire and compare with the theoretical curves.
9. To obtain polar curve of the light distribution of a flood lighting luminaire.
10. Study the following:
    a) The effect of the cover glass upon the beam spread and
    b) The effect of lamp focus on beam spread
11. To calculate Glare index of a luminaire.
12. To control light of a luminaire by various method.
13. Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp.
14. Compare performance of magnetic and electronic ballast. Estimate the energy saving with electronic ballast.
15. Understand energy efficient illumination equipments.
16. Design illumination scheme for any one of the following.
    (A)Flat (B) Bungalow (C) Row House and similar
17. Design illumination scheme for any one of the following.
    (A) Mall (B) Cloth shop (C) Restaurant (D) Showroom.
18. Write a report on illumination scheme used in industry by visiting small or medium industry.
19. Conduct illumination assessment in workplace using lux meter
20. Understand biological implication of artificial illumination.

OEC-EE-703(A) Elecrical Installation,Testing & Maintenence

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE703(A)	Open Elective –III (Electrical Installation, Testing & Maintenance)	3	0	2	4	25#	-	25	15	35	100

Course Objective:

1. To develop basic knowledge of tools, accessories and instruments required for installation, maintenance and repair work.
2. To develop basic knowledge of Installation of Transmission and Distribution Lines
3. To develop basic knowledge of Inspection, storage, transportation and handling of cables and Trasformers.
4. To develop basic knowledge of types of maintenance, maintenance schedules and procedures.

Module1: Tools & Accessories (2 Hrs)

Tools, accessories and instruments required for installation, maintenance and repair work, India Electricity rules, safely codes causes and prevention of accidents, artificial respiration, workmen's safety devices.

Module 2: Installation of Transmission and Distribution Lines (6 Hrs)

Erection of steel structures, connecting of jumpers, tee-off points, joints and dead ends: crossing of roads, streets, power/telecommunication lines and railway crossings clearances: Earthing of transmission lines and guarding, spacing and configuration of conductors, Arrangement for suspension and strain insulators, bird guards anti-climbing devices and danger plates. Sizes of conductor earth wire and guy wires. Testing and Commissioning Laying of service lines Earthing, provision of service fuses, installation of energy meters

Module 3: Laying of Underground Cables (8 Hrs)

Inspection, storage, transportation and handling of cables, cable handing equipment, cable laying depths and clearances from other services such as water sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying (including laying of cable from the drum, laying cable in the trench, taking all measurements and making as installed drawing, back filling of trenches with earth or sand, laying protective layer of bricks etc). laying of cables into pipes and conduits and within buildings introduction to cable filling compounds epoxy resins and hardeners, cable jointing and terminations testing and commissioning.

Module 4: Inspection and handling of transformers (4 Hrs)

Pole mounted substations, plinth mounted substation, busbars, isolation, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches.

Module 5: Testing of various electrical equipment (4 Hrs)

Electrical motor, transformers cables and generator and motor control centers, medium voltage distribution panels power control centers motor control, lighting arrangement, storage, pre-installation checks, connecting and starting precommissioning checks drying out

Module 6: Maintenance (6 Hrs)

Types of maintenance, maintenance schedules, procedures, Maintenance of Transmission and Distribution System, danger notice, caution notice permit to work, arranging of shutdowns personally and temporary earths cancellation of permit and restoration of supply, Patrolling and visual inspection of lines points to be noted during patrolling from ground: special inspections and night inspections, Location of faults using Meggar, effect of open or loose neutral connections provision of proper fuses on service lines and their effect on system, causes and dim and flickering lights

Module 7: Maintenance of Distribution Transformers (4 Hrs)

: Transformer maintenance and points to be attended to be attended to in respect of various items of equipment, Checking of insulation resistance transformer oil level and BDV test of oil, measurement of earth resistance

Module 8: Maintenance of Grid Substations (2 Hrs)

Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches, Power Transformers 16

Module 9: Maintenance of Motors (2 Hrs)

Over hauling of motors, preventive maintenance, trouble shopping of electric motors

Module10: Domestic installation (4 Hrs)

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth testing of insulation and resistance between conductors continuity or open circuit test, short circuit test testing of Earthing continuity location of faults IE rules for domestic installation

Course outcome:

After the completion of the course the student will be able to

- Know I.S. codes/I.E. Rules & safety measures related to electrical machines.
- Identify / Locate common troubles in electrical machines.
- Plan & carry out routine & preventive maintenance
- Prepare trouble-shooting charts for electrical machines.
- Ascertain the condition of insulation & revarnishing if necessary.
- Initiate total productive maintenance.

References Books:

1. Testing, Commissioning Operation and Maintenance of Electrical Equipment : S Rao, Khanna Technical Publication ,New Delhi

2. Preventive Maintenance of Electrical Apparatus : SK Sharotri, Katson Publishing House Ludhiana

3. Design & Testing of Electrical Machines: M.V. Deshpande, PHI learning private Ltd. New Delhi

4. Operation & Maintenance of Electrical Equipments Vol-I & II: B.V.S. Rao, Media promoters and publisher Ltd. Mumbai

List of Practical's:

A)

1. Identification of tools and equipment used for installation and maintenance of electrical equipment

2. Study of codes and practices pertaining to safety in installation and maintenance of electrical equipment.

3. Study of electrical equipment by visiting a grid power station/substation and to prepare a report of maintenance system adopted there

4. Study of the testing of electrical equipment by visiting a grid power station/substation and to prepare a report

5. Study of motors and their repair and overhauling by visiting a repair workshop or manufacturing unit

6. Study of maintenance of electrical distribution system by visiting a substation and to prepare a report.

7. Study of Power factor improvement of a single-phase load using capacitor bank

8. Determine Breakdown Strength of Transformer Oil by using Oil Testing Kit.

9. Prepare Troubleshooting Charts for Single Phase and Three Phase Induction Motor.

10. Measure Insulation resistance of Transformer winding , Stator and Rotor of A.C. Rotating Machines using Megger.

11. Measure the Resistance of Earth Electrode using Earth Tester.

12. Calculate Regulation and Efficiency bye Back to Back connection of single phase Transformer.

B) One field visit to substation for study of maintenance work.

OEC –EE-703(B) Microcontroller Application in Electrical Engineering)

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE703(B)	Open Elective – III (Microcontroller Application in Electrical Engineering)	3	0	2	4	25#	-	25	15	35	100

Course Objectives:

1. To introduce students the use of microcontrollers for electrical systems.
2. To enable the students to understand the analysis of physical systems using microcontrollers.
3. To enable students to understand use of sensors and signal conditioning on microcontroller platform.
4. To introduce the use of Arduino for control of different electrical systems.

Module 1: Development tools and Hardware Features (8 Hrs)

Open source microcontroller platforms, Choice of microcontroller, Development tools-Editors, Assemblers, Compilers, Linkers, Simulators, Emulators, Debugger Programmers, and Introduction to Arduino, Headers and Preprocessor Directives, Basic Programming in C.

Module 2: Sensors and Signal Conditioning (6 Hrs)

Hall Effect Sensors for current and voltage measurement, Speed sensors, measurement of active and reactive power, flow and pressure measurement, temperature transducers, interfacing of sensors to Arduino.

Module 3: Embedded Control for DC machines (6 Hrs)

Speed control of dc motor using arduino, speed control using single phase controlled converter, three phase controlled converter, dc to dc chopper, and code for switching sequences.

Module 4: Embedded Control for dc to dc converters (8 Hrs)

Types of DC to DC converters- buck, boost, buck-boost, choice of components, implementation using Simulink, frequency control/ on time control for dc to dc converters.

Module 5: Inverter Control (6 Hrs)

3 phase PWM inverter design, choice of components, implementation of 120 degree and 180 degree mode of conduction methods, Selection of sampling period and Switching frequency, PWM control techniques.

Module 6: Control Systems Design (6 Hrs)

Controller Specifications, design of controller using arduino, P, PI and PID controller design, closed loop control of physical systems, temperature control systems, and use of DAQ in closed loop systems.

Course Outcomes:

After completion of the course students will be able to:

- Explain features of microcontroller and various development tools.
- Demonstrate use of different sensors and signal conditioning using microcontrollers
- Implement speed control techniques for dc motor using Arduino.
- Understand and evaluate use of microcontrollers for dc to dc converters.
- Implement basic power electronics circuits using microcontroller.
- Use Arduino for implementing basic controllers viz. P,PI and PID

References:

1. Michael McRoberts,"Beginning Arduino", Apress, 1st edition
2. Norman Nise, „Control System Engineering", John Wiley, Sixth Edition, 2011.
3. G. K. Dubey,"Fundamentals of Electrical Drives", Narosa publication, 2nd edition
4. Massimo Banzi, "Getting Started with Arduino,", Shroff publications,3rd edition
5. https://www.arduino.cc/en/Tutorial/ Arduino Examples
6. M.H. Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 3rd Edition

List of Practical's:

1. Interfacing Hall Effect current sensors to Arduino.
2. Interfacing Hall Effect voltage sensors to Arduino.
3. Measurement of power using Arduino.
4. Speed control of DC motor using Arduino (single phase controlled converter method)
5. Speed control of DC motor using Arduino (DC to DC chopper method)
6. Buck converter using Arduino.
7. Boost converter using Arduino.
8. Pulse generation for PWM inverter using 120 degree mode of conduction.
9. Pulse generation for PWM inverter using 180 degree mode of conduction.
10. Study of P, PI, PID controllers using Arduino

Computer Usage / Lab Tool:

Use of software simulation tools like MATLAB/Simulink, LABVIEW, Arduino compiler

OEC-EE-704(A) Advanced Power Electronics

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE704(A)	Open Elective – IV(Advanced Power Electronics)	2	0	2	3	25@	-	25	15	35	100

Course Objectives:

1. This course intends to provide advanced knowledge of different power electronic converters, multi-level inverters and resonant converters.
2. It is aimed to impart skills of analysis for different types of advanced converters and shunt active power filters.
3. Make the students acquainted with control strategies of different types of advanced converters and shunt active power filters.

Module 1: PWM rectifiers (4 Hrs)

Advantages & disadvantages of three phase thyristor converter, PWM converters working, types, Control of PWM rectifiers, analysis and application

Module 2: Multilevel inverters (6 Hrs)

Three phase two level inverter, Multilevel inverter, Types: Diode clamp multilevel inverter, flying capacitor multilevel inverter, cascaded multilevel inverter, applications of multilevel inverters, comparison of multilevel inverter. Control method: sinusoidal PWM, selective harmonic elimination, carrier PWM, space vector PWM.

Module 3: Resonant pulse inverters (6 Hrs)

Series resonant inverter with unidirectional and bi-directional switches, parallel resonant inverters, voltage control of resonant inverters, zero current and zero voltage switching resonant converters, two-quadrant ZVS resonant converters, resonant DC link inverters

Module 4: High power factor converters (6 Hrs)

Need of HPFC, converters employing Line commutation and forced commutation, Single phase active PFC, analysis of single phase boost rectifier, Voltage doubler PWM rectifier, Three phase PFC circuits.

Module 5: Matrix Converters and Z source inverters (4 Hrs)

Topology, working and control methods of Matrix converters, Various circuit topologies and control of Z source inverter, Application of Z source in induction motor control

Module 6: Active power filters (6 Hrs)

Power Quality Issues due to power Electronics, Introduction to active power filter, types of active power filters overall control of shunt active power filter, harmonic compensation & reactive power compensation

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Explain the PWM converters, their advantages and applications.
- Control the multilevel inverters.
- Design and simulate resonant converters.
- Simulate the z-source inverter.
- Design active filter for non-linear load.

References Books:

1. M. H.Rashid, Power Electronics: circuits devices and applications, Pearson Education, Third edition.
2. B. K. Bose, Modern Power Electronics & AC drives, PHIPL, New Delhi.
3. M. B. Patil, V. Ramayanan and V. T. Ranganathan, Simulation of Power Electronics circuits, Narosa publication.
4. IEEE Transaction papers.

List of Practical's:

1. Development of Simulink model and analysis of performance of Single Phase Full controlled converter.
2. Development of Simulink model and analysis of performance of Single Phase Half controlled converter.
3. Development of Simulink model and analysis of performance of Three Phase Full controlled converter
4. Development of Simulink model and analysis of performance of Three Phase Half controlled converter
5. Development of Simulink model and analysis of performance of Cascade type Multilevel Inverter.

6. Development of Simulink model and analysis of performance of Diode clamped Multilevel Inverter.
7. Experimental study of cascade type Multilevel inverter
8. Development and performance analysis of Active power Filter
9. Development of Simulink model and analysis of performance of Z source inverter
10. Study and performance analysis of Matrix converter.

Computer Usage / Lab Tool: Simulation Lab and Power Electronics Lab

OEC-EE-704(B) Embedded System

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE704(B)	Open Elective –IV (Embedded system)	2	0	2	3	25@	-	25	15	35	100

Course Objective:

1 Study of RISC architecture.

2 Understanding and usage of ARM development tools.

3 Understanding linux kernel and device driver programming.

4 Study, design and develop various embedded applications using ARM processor.

Module 1: Introduction to Embedded systems. (6 Hrs)

Embedded systems vs. general computing systems. Introduction to different embedded processors like 8051, ARM, PIC, DSP, and FPGA based processors etc. Hardware/software code sign, code sign for system specification and modelling. Single processor architectures and multiprocessor architectures. The co synthesis Problem. State transition graph.

Module 2: Models of computation: (6 Hrs)

Requirements for embedded system specification, hardware/software partitioning problem, and hardware/software cost estimation. Generation of partitioning using different modelling technique, external peripherals types of memory and their management, case studies.

Module 3: Introduction to RTOS (6 Hrs)

OS in embedded SoC. Introduction to tasks, process and threads. Multiprocessing and multitasking. Task scheduling. Inter process communication, message passing, interrupt driven input and output Non mask able interrupt, software interrupt. Threads single, multithread concept; multitasking sequential circuit, task synchronization techniques. Handling of interrupts in RTOS and timing analysis. Case studies.

Module 4: Embedded system modeling (6 Hrs)

Embedded C, role of infinite loop, instruction sequencing, compiling, state machine, pattern sequence detector, different types of embedded multitasking sequential switching circuit design and optimization. Case studies.

Module 5: Embedded System (8 Hrs)

Introduction, block diagram, applications, advantages and disadvantages. Classification of Embedded System Small scale, medium scale, sophisticated, stand-alone, reactive/real time (soft and hard real time), Networked, Mobile, Single functioned, Tightly constrained, Design Metrics/Specifications/Characteristics of Embedded System: Processor power, memory, operating system, Reliability, performance, power consumption, NRE cost, unit cost, size, flexibility, time-to-prototype, time-to-market, maintainability, correctness and safety.

Course Outcome:

Students will be able to:

- Understanding of RISC architecture of processor, its features and applications.
- Hands on usage of IDE of processors and algorithm development.
- To understand concept of OS, RTOS and application perspectives.
- Study, design, analyze and prototype various embedded systems.

Reference Books:

1. W. Wolf, "Computers as components: Principles of embedded computing system design", 2/e, Elsevier, 2008.
2. R. Gaonkar, " Fundamentals of Microcontrollers and Application in Embeded Systems," Penram International Publishing, 2015
3. A. N. Sloss, D. Symes, and C. Wright, "ARM system developer's guide: Designing and optimizing system software", Elsevier, 2008.
4. Product data sheet LPC 2141/42/44/46/48. NXP Semiconductors.
5. ARM7TDMI Technical Reference Manual, ARM Limited
6. Jack Ganssle, "The art of designing embedded systems", 2/e, Elsevier, 2008
7. Michael Barr, "Programming Embedded Systems in C and C++", O'Really, 1999.
8. Kirk Zurell, "C Programming for Embedded Systems", CMP Books, 2000.

9. Muhammod Ali Mazidi, Rolin D. Mckinlay & Danny Sansey, "PIC Microcontroller and Embeded System Using Assembly & C for PICI8," Pearson International Edition, 2008.
10. Muhammod Ali Mazidi, Janice Gillispie Mazidi & Rolin D. Mckinlay, "The 8051 Microcontroller and Embeded System Using Assembly & C," Pearson India.

List of practical's:

1. Design an embedded controller for automatic room temperature control.
2. Design an FPGA based embedded SoC system.
3. Design an embedded system for industrial automation.
4. Design an embedded system for AUV.
5. Design an embedded system for Robot gripper.
6. Design an embedded system for wheel mechanism of mobile robot.
7. Design an embedded system for obstacle avoidance by an assembly line robot.
8. Any innovative embedded system design as mini project.

PROJ-EE-705 Project-I (Project work, and seminar) in industry or at appropriate work place)

Category	Code	Course Title	L	T	P	C R	PR	OR	TW	MSE	ESE	Total Marks
Project	PROJEE-705	Project-II(Project work, Seminar and Internship in industry or at appropriate work place)	0	0	10	5	--	50@	50	-	-	100

Survey for Project Selection	**05 Marks**
Selection of Problem/ Project	**05**
Presentation for selection of project	**05**
Weekly Report for continued assessment 1	**05**
2	**05**
3	**05**
4	**05**
5	**05**
Final Presentation for Project 6	**10**
	Total =50*
Weightage	**Oral 50* Marks by Internal Guide and Observer**
	TW of 50 Marks by Internal Guide

MC706 Industrial Internship Training

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Mandatory	MC 706	Industry Internship	0	0	0	0	-	25#	25	-	-	50

In industry between completion of VI Semester Examination and Commencement of VIIth Semester.

Assesment is to be done at start of VIIth semester.

HSMC-EE-707 Interview & Mock Techniques

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Humanities and Social Sciences including Management Courses	HSMC707	Interview Techniques and Mock Exercise	0	0	2	1	-	25@	25	-	-	50

Course Objectives:

The course is designed to address the following:

1. To explore the interview skills and techniques to the Engineering aspirants.
2. To understand the selection processes and procedures via group discussions, aptitude tests and psychometric tests.
3. To inculcate an essential interview etiquettes, manners and a kind of professionalism amongst the aspirants.
4. To train budding Engineering for Interview Processes so as to excel in their respective industrial field.

Module 1: Pre Interview Functions

Know yourself, know the Interview Process, Selection Criteria, Types of interviews Interview Competencies, Keys to Succeed in Interview

Module 2: Interview Process and Candidates

Candidate Philosophyfor Interview, Reason for Selection and Rejection of Candidates Common Mistakes during Interview, Do's and Don'ts of Interviews, Physical Appearances for Interview, FAQs in the Interview

- **Test 01:** Aptitude Test in Interview
- **Test 02:** Psychometric Test in Interview

Module 3: Group Discussion and Selection Process

Group Discussion: Meaning and Importance, Why Group Discussion, Types of Group Discussion, Essential Skills Required For Group Discussion, Group DiscussionEtiquettes, Non-Verbal Communication in Group Discussion

- Test 01: Perform Group Discussion in Classroom
- Test 02: Watch Group Discussion Videos

Module 4: Interview Etiquettes and Manners

Interview Etiquettes and Manners, Humility, Honesty and Sincerity, Practicing Good Manners

Tips for Corporate Grooming, Professionalismand Socializing Skills

- **Exercise 01:** Test Your Etiquette
- **Exercise 02:** Test Your Manners

Module 5: Preparing Resume

Drafting for Interview, Drafting Job Application, Drafting and Sending Emails, Bio-data, CV and Resume, Tips for CV/ Resume Writing

Module 6: Interview Exercise

Find out different aptitude tests applied in selection processes of MNC's and prepare for the same, Find out and solve 03 question papers of Aptitude Tests to improve your technical competencies. Watch group discussion videos and learn group discussion techniques. Watch mock interviews of students and identify common mistakes done by them. **,** Perform interviews in classroom, record students' performance and reflect upon their mistakes.

Course Outcome:

After learning the course the students should be able to:

- Learners would be familiar with different interview skills and techniques employed in the industrial and the corporate world.
- Students would be able to perform well in interview by developing body language, rationalizing their aptitude and attitude for the interview.
- They would be able to participate effectively in group discussions, accept leadership and express their ideas effectively.
- Students would be able to draft effective job applications and resume, CVs accurately as per the needs of the industries.

- Students would develop right frame of mind by learning socializing skills, corporate etiquettes, and manners.

Reference:

1. How to Win interview – TusharKokane – Educreation Publications New Delhi
2. Soft Skills – Know yourself and Know your world by Dr.K.Alex – S.Chand and Publications, New Delhi
3. The Ace of Soft Skills, by Gopalswamy Ramesh and Mahadevan Ramesh, Pearson. 2010.

Swami Ramanand Teerth Marathwada University, Nanded

B.E Final Year in Electrical Engineering & Electical, Electronics and Power (Revised Syllabus, CGPA Revised) Effective from 2021-22

PEC-EE-801(A) Power Quality & FACTS

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Professional Elective Courses	PEC – EE 801(A)	Elective-VI (Power Quality & FACTS)	3	0	2	4	25@	-	25	30	70	150

Course Objectives :

1. This course is intended to introduce terms and definitions of power quality disturbances, and their causes, detrimental effects and solutions.

2. It provides the insights of latest development in the field of flexible AC transmission systems and its applications to power systems.

Module 1: Introduction to Power Quality (4 Hrs)

Introduction, Electromagnetic phenomena – Transients, Long and short duration voltage variations, wave form distortion**.**

Module 2: Fundamentals of Harmonics (6 Hrs)

Representation characteristic harmonics, Harmonic indices Harmonic sources-6&12 pulse related harmonics, harmonic effects on power apparatus and on measurements, interference with communications

Module 3: Harmonic Mitigation Techniques (6 Hrs)

Shunt passive filters, types, Design considerations and illustrative examples, Active filters: types, current and voltage source active filters, shunt, series & Hybrid active filters, Detuned filters.

Module 4: Reactive-Power Control in Electrical Power Transmission (6 Hrs)

Power flow in AC Systems. Definition of FACTS. Power Flow Control. Constraints of maximum transmission line loading. Benefits of FACTS Transmission line compensation: Uncompensated line, shunt compensation. Series compensation, Phase angle control.

Module 5: Principles of Conventional Reactive-Power Compensators (10 Hrs)

The Saturated Reactor (SR), The Thyristor-Controlled Reactor (TCR), Operating Characteristics of a TCR, The Thyristor-Controlled Transformer (TCT), The Fixed Capacitor–Thyristor-Controlled Reactor (FC–TCR), The Mechanically Switched Capacitor–Thyristor-Controlled Reactor (MSC–TCR), The Thyristor-Switched Capacitor (TSC), The Thyristor-Switched Capacitor–Thyristor-Controlled Reactor (TSC–TCR), A Comparison of Different SVCs.

Module 6: The Thyristor-Controlled Series Capacitor (TCSC) (8 Hrs)

Series Compensation, The TCSC Controller, Operation of the TCSC, Analysis of the TCSC, Capability Characteristics, Harmonic Performance, Losses.

Course Outcomes:

After the completion of the course the student will be able to:

- Comprehend fundamentals of Power Quality problems.
- Explain the concept of harmonics and related problems.
- Design harmonic mitigation systems to counter power quality problems.
- Explain basic concepts of FACTs devises and controllers.
- Explain the characteristics, applications and modelling of shunt FACTS controllers.
- Explain the characteristics, applications and modelling of series FACTS controllers.

Reference Book:

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.

2. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.

3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.

4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.

5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991

List of Practicals:

The experimental lab shall have typically 8-10 experiments.

Practical's on Power Quality

1) Generation of different power quality disturbances.

2) Simulation of mitigating device for voltage sag.

3) Simulation of mitigating device for overvoltages/transients.

4) Simulation of harmonic producing load and mitigating filter.

5) Site survey for PQ analysis using PQ monitoring instruments.

Practical's on FACT Devices

The entire practical to be performed in MATLAB

6) To study and develop use of SVC in transmission line.

7) To study and develop use of TCSC in transmission line.

8) To study and develop use of UPFC in transmission line.

9) To develop VAR compensator in transmission line.

10) To develop 3phase load balancing with parallel compensation.

11) To develop a model of TCSC and show enhancement in system damping and improved stability.

12) To develop voltage and current profile of unloaded long transmission line.

13) To develop effect of loading on long transmission line.

14) To develop effect of compensating on long transmission line with regards to reactive power.

15) To develop STATCOM compensation on transmission line and plot its V-I characteristics.

OEC-EE-801(B) VLSI Circuit

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Professional Elective Courses	PEC – EE 801(B)	Elective-VI (VLSI Circuit)	3	0	2	4	25@	-	25	30	70	150

Course Objectives:

1. Develop the logical and design skills MOS Technologies
2. To Understand Basic Electrical Properties of Mos, Cmos & Bicoms Circuits
3. Develop understanding of Layout Design and Tools
3. Develop the logical and design skills of CMOS combinational and sequential circuits

Module 1: REVIEW OF MICROELECTRONIC S AND INTRODUCTION TO MOS TECHNOLOGIES: **(4 Hrs)**

(MOS, CMOS, Bi - CMOS) Technology trends and projections.

Module 2: BASIC ELECTRICAL PROPERTIES OF MOS, CMOS & BICOMS CIRCUITS: **(6 Hrs)**

Ids -Vds Relationships, Threshold Voltage Vt, Gm, Gds and Wo, Pass Transistor, MOS,CMOS & Bi - CMOS Inverters, Zpu/Zpd, MOS Transistor Circuit Model, Latch - Up in CMOS Circuits.

Module 3: LAYOUT DESIGN AND TOOLS: **(4 Hrs)**

Transistor Structures, Wires and Vias, Scalable Design Rules, Layout Design Tools.

Module 4: LOGIC GATES & LAYOUTS: **(4 Hrs)**

Static Complementary Gates, Switch Logic, Alternative Gate Circuits, Low Power Gates, Resistive and Inductive Interconnect Delays.

Module 5: COMBINATIONAL LOGIC NETWORKS: **(6 Hrs)**

Layouts, Simulation, Network delay, Interconnect Design, Power Optimization, Switch Logic Networks, Gate and Network Testing.

Module 6: SEQUENTIAL SYSTEMS: (4 Hrs)

Memory Cells and Arrays, Clocking Disciplines, Design, Power Optimization, Design Validation and Testing.

Module 7: FLOOR PLANNING & ARCHITECTURE DESIGN: (6 Hrs)

Floor Planning Methods, Off Chip Connections, High Level Synthesis, Architecture for Low Power, SOCs and Embedded CPUs, Architecture Testing.

Module 8: INTRODUCTION TO CAD SYSTEMS (ALGORITHMS) AND CHIP DESIGN: **(6 Hrs)**

Layout Synthesis and Analysis, Scheduling and Printing; Hardware - Software Co - design, Chip Design n Methodologies - A simple Design Example.

Course Outcome:-

Student will be in a position that he/she can design vlsi circuits starting from pmos nmos, cmos, and bicmos technology based design

- Gains thorough knowledge on design tools to draw layouts for the transistor structures
- The student will understand the design of logic gates
- The student will understand the design of sequential system

Reference Books:

1. Essentials of VLSI Circuits and Systems, K. Eshraghian et . al(3 authors) PHI of India Ltd.,2005

2. Modern VLSI Design, 3rd Edition, Wayne Wolf , Pearson Education, fifth Indian Reprint, 2005.

3. Principals of CMOS Design – N.H.E Weste, K.Eshraghian, Adison Wesley, 2nd Edition.

4. Introduction to VLSI Design –Fabricius, MGH International Edition, 1990.

5. CMOS Circuit Design, Layout and Simulation –Baker, Li Boyce, PHI, 2004.

List of Practical's:-

1. Introduction to programmable devices (FPGA, CPLD), Hardware Description Language (VHDL), and the use programming tool.
2. Implementation of basic logic gates and its testing.
3. Implementation of adder circuits and its testing.
4. Implementation 4 to 1 multiplexer and its testing.
5. Implementation of 3 to 8 decoder and its testing.
6. Implementation of 8 to 3 priority encoder and its testing.
7. Implementation of J-K and D Flip Flops and its testing.
8. Implementation of sequential adder and its testing.
9. Implementation of BCD counter and its testing.
10. Implementation of two 8-bit multiplier circuit and its testing.
11. Simulation of CMOS Inverter using SPICE for transfer characteristic.
12. Simulation and verification of two input CMOS NOR gate using SPICE.
13. Implementation and simulation of given logic function using dynamic logic.
14. To generate layout for CMOS Inverter circuit and simulate it for verification.
15. To prepare layout for given logic function and verify it with simulations.
16. To measure IDS – VGS and IDS – VDS characteristics of given n-channel and p-channel MOSFETs.

PEC-EE-802(A) Electrical & Hybrid Vechicles

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE802(A)	Open Elective-V (Electrical & Hybrid Vehicles)	3	0	2	4	25@	-	25	30	70	150

Course Objectives:

1. To develop basic knowledge related to architecture of Electric Vehicles

2. To provide knowledge related to design aspects and dynamics of Electric vehicles

3. The course aims at enabling students to understand the motor specifications and charging standards for Electric vehicles**.**

4. Develop basic ideas about different energy storage systems

Module 1: Introduction (6 Hrs)

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Module 3: Electric Trains (8 Hrs)

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Module 4: Energy Storage (8 Hrs)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Module 5: Energy Management Strategies (8 Hrs)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Course Outcomes:

- At the end of this course, students will demonstrate the ability to
- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

Reference Book:

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.

2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.

4. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

List of Practical's:-

1) To study the History of Hybrid and electric Vehicle.

2) To study the concept of hybrid train and hybrid drive train topology.

3) To study the power flow control in hybrid drive-train topologies.

4) To Study the electric components used in hybrid and electric vehicles.

5) To study the Configuration and control of DC Motor drives & Induction Motor drives.

6) To study the Energy Storage Requirements in Hybrid and Electric Vehicles.

7) To study the energy management strategies used in hybrid and electric vehicles.

8) To study classification of different energy management strategies.

9) To study the Communications & supporting subsystems in hybrid & Electric Vechicles.

10) Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

OEC-EE-802(B) Digital Signal Processing

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE802(B)	Open Elective-V (Digital Signal Processing)	3	0	2	4	25@	-	25	30	70	150

Course Objective:

1. To elaborate Sampling theorem, classification of discrete signals and systems
2. To analyze DT signals with Z transform, inverse Z transform and DTFT
3. To describe Frequency response of LTI system
4. To introduce Digital filters and analyze the response
5. To demonstrate DSP Applications in electrical engineering

Module 1: Introduction: (6 Hrs)

Discrete time signals and systems, time domain characterization of discrete time LTI systems, sampling theorem, benefits and limitations of processing signal digitally. Correlation of signals. The Z-transform: inverse Z-transform and Z-transform properties for one-sided and two-sided z-transforms. Discrete Time Fourier Transform (DTFT) and its properties.

Module 2: LTI Discrete Time Systems in transform domain: (6 Hrs)

The frequency response, the transfer function, types of transfer functions, All pass transfer function, minimum-phase and maximum-phase transfer functions, inverse systems.

Module 3: Discrete Fourier Transform: (6 Hrs)

Discrete Fourier Transform (DFT) and its properties. Computation of DFT (FFT algorithms), Decimation-In-Time (DIT), Decimation-In-Frequency (DIF) and radix-n algorithms of FFT

Module 4: Digital Filter Structures: (8 Hrs)

Digital filter structures: block diagram representation, equivalent structures, basic FIR structures, basic IIR structures, All pass filters, IIR tapped cascaded lattice structures, FIR cascaded lattice structures.

Module 5: Digital filter design IIR filter design: (6 Hrs)

Bilinear transformation, impulse invariant transformation, Lowpass IIR digital filters, spectral transformations, FIR filter design using windowing techniques, frequency sampling technique, and computer aided design.

Module 6: Digital Signal Processor (8 Hrs)

Harvard architecture and modified Harvard architecture. Introduction to fixed point and floating point DSP processors, architectural features, computational units, bus architecture and memory architecture, data addressing, address generation unit, pipelining, on-chip peripherals.

Course Outcomes:

- Sample and reconstruct any analog signal
- Find frequency response of LTI system
- Find Fourier Transform of discrete signals
- Design of IIR & FIR filter
- Implementation of IIR and FIR filter
- Develop DSP Algorithm for various application

Reference Book:

1. E. C. Ifeachor, B. W. Jarvis, Digital Signal Processing- A Practical Approach, Second Edition, Pearson Education, New Delhi, 2002.
2. S. K. Mitra, Digital signal processing- A computer based approach, Tata McGraw Hill, 2002
3. A.V. Oppenheim, R, W, Schafer, Discrete time signal processing, Prentice-Hall ofIndia, 2001.
4. J. G. Proakis, D. G. Manolakis, Digital signal processing –Principles, algorithms and applications, Prentice Hall of India, 2002.
5. R. G. Lyons, "Understanding Digital Signal Processing", Pearson Education New Delhi, 1999.

List of Practical's:-

1. To generate discrete sequence using software tool
2. To Perform Operation on Sequence using software tool.
3. To represent basic signals (Unit step, unit impulse, ramp, exponential, sine and cosine).
4. To develop program for discrete convolution
5. To develop program for discrete correlation.
6. To understand stability test.

7. To Perform Z Transform and Inverse Z-Transform and to find Poles, Zeros and gain from a given Z-Transform using software tool.
8. To understand sampling theorem
9. To design analog filter (low pass, band pass, band stop, high pass filter).
10. To design digital IIR filter (low pass, band pass, band stop, high pass filter).
11. To design FIR filter using windows technique.

Note: The computational work is to be carried preferably by using software tools likeMATLAB, Scilab.

OEC-EE-803(A) Electrical System Planning & Designing

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE803(A)	Open Elective-VI (Electrical System Planning & Designing)	3	0	2	4	25@	-	25	30	70	150

Course Objective:

1. To develop skills for designing of simple electrical circuits
2. To develop skills for design of power and control circuits.
3. To develop skills for designof different illumination schemes.
4. To understand different Electrical installations

Module 1: Design of Simple Electrical Circuits (6 Hrs)

Introduction, simple light and fan circuits, system of connection and accessories, solved examples on light and fan circuits, introduction of simple alarm circuits without and with relays.

Module 2: Design of Power and Control Circuit Installation (8 Hrs)

Introduction, Design consideration of Electrical installation, Protection devices such as fuse, Earthing and requirements such as Soil Resistivity, Electrode, Types of earthing, Single phase and three phase installation for residential load, Busbar and Busbar chambers, Mounting of CTs and PTs.

Module 3: Design of Illumination Schemes (6 Hrs)

Introduction, Terminology in Illumination, Laws of Illumination, Various types of Light Sources, Practical lighting schemes, solved examples on lighting scheme.

Module 4: Substation (6 Hrs)

Introduction, Types of substation, Equipment and Accessories, Outdoor substation-pole mounting type and their SLD & estimation, Indoor substation- floor mounting type and their SLD & estimation.

Module 5: Electrical Installation for Different Types of Building and Small Industries

(6 Hrs)

Electrical installation for commercial buildings, Electrical installation for small industries, PFC and APFC panel installation.

Module 6: Motor Control Circuits (8 Hrs)

Starting of 3- phase squirrel cage induction motor, Starting of multi speed squirrel cage induction motor, starting of wound rotor motor, starting of synchronous motor, Stopping of motor, Contactor-relay logic control circuit components and wiring, schematic, ferruling relay boards, connector boards etc.

Course Outcomes:

At the end of theis course students will demonstrate the ability to

- Design of Simple Electrical Circuits
- Design of Power and Control Circuit Installation
- Find use of Earthing and its requirements
- Various types of lighting schemes and Illumantaion
- Identify substation equipments and accessories
- Design Electrical installation for different utilities

Reference Books:

1) Electrical Design Estimating And Costing by K.B. Raina, S.K. Bhattacharya, New Age international LTD Publishers.

2) Electrical Wiring – Estimating & Costing By S.L. Uppal, Khanna Publishers.

3) Electrical Installation Estimating & Costing By J.B. Gupta, S.K. Kataria & Sons Publishers.

4) Residential, Commercial and Industrial Electrical Systems by Hemant Joshi, Tata Mcgraw-Hill Publishers.

5) Performance & Design of A.C. Machines by M.G.Say, CBS Publishers.

6) Performance & Design of D.C. Machines by A. E. Clayton & N. N. Hancock CBS Publishers.

7) Manual of Auto CAD.

List of Practical's:

1. Electrical Drawing using design data or sketches or Computer Aided Electrical Drawing

a) Drawing sheet on problems solved on the topics of each unit.

b) Drawing sheet on Single line diagram of generating station and substation.

OR

2) Electrical Drawing using design data or sketches or both

a) Drawing on problems solved in the topics of each unit.

b) Transformer -sectional views of single and three phase core and shell type transformer.

c) D.C. Machine- sectional views of yoke, field system, armature and commutators.

d) Alternator- sectional views of stator and rotor.

3) Winding Diagrams

a) D.C. Machine- Simplex and multiplex double layer lap and wave windings

b) A.C. Machine- Single layer windings- Un-bifurcated 2 and 3 tier windings, mush winding, Integral and fractional slot double layer lap and wave winding

OEC-EE-803(B) Electromagnetic Waves

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Open Elective Courses	OEC-EE803(B)	Open Elective-VI (Electromagnetic Waves)	3	0	2	4	25 @	-	25	30	70	150

Course Objectives:

1. This course develops foundational concepts in electrostatic and electromagnetic waves.
2. It familiarizes the students with electrical field and scalar potential, magnetic field and vector potential, Maxwell‟s equations, Gauss's law, Ampere's Circuital law, Faraday's law, electrostatic boundary conditions, time varying potential.
3. This course will help students in preparing for competitive examinations

Module 1: Transmission Lines **(8 Hrs)**

Introduction, Concept of distributed elements, Equations of voltage andcurrent, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Module 2: Maxwell's Equations **(6 Hrs)**

Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

Module 3: Uniform Plane Wave **(6 Hrs)**

Homogeneous unbound medium, Wave equation for time harmonic fields,Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Module 4: Plane Waves at Media Interface **(8 Hrs)**

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Module 5: Waveguides **(6 Hrs)**

Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Module 6: Antennas **(6 Hrs)**

Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Analyze transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
- Provide solution to real life plane wave problems for various boundary conditions.
- Analyze the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
- Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
- Understand and analyses radiation by antennas.

Reference Books

1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill, 2005.

2. D. K. Cheng, "Field and Wave Electromagnetics**"**, Addison-Wesley, 1989.

3. M. N.O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press, 2007.

4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.

5. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons, 2005.

List of Practicals:-

Note:- Hands on Experiments on Above Contents

PROJ-EE-804 Project –II(Continued from VII Semester Project work, seminar and internship in industry or at appropriate work place

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Project	PROJ-EE 804	Project-III(Continued from VII Semester, Final Project work, Testing, Result, Conclusion & future scope , Seminar, and Prepare a paper for conference Presentation/ Publication in Journal)	0	0	10	5	----	150#	50	-	-	200

Survey for Project Selection	**05 Marks**
Selection of Problem/ Project	**05**
Presentation/Project	**05**
Presentation for selection of project	**05**
Weekly Report for continued assessment 1	**05**
2	**05**
3	**05**
4	**05**
5	**05**
Final Presentation for Project 6	**05**
	Total =50*
Weight	**TW 50* Marks by Internal Guide**
	Oral 150 Marks by Internal Guide and External examiner

HSMC-806 Entrepreneurship Development

Category	Code	Course Title	L	T	P	CR	PR	OR	TW	MSE	ESE	Total Marks
Humanities and Social Sciences including Management Courses	HSMC 805	Entrepreneurship Development	0	0	2	1	-	25 @	25	0	0	50

Course Objectives:

The course is designed to address the following:

1. Identifying your entrepreneurial traits.
2. Identifying business opportunities that suites student's.
3. Use the support system to zero down to students Business Idea.
4. Develop comprehensive business plans.
5. Prepare plans to manage the enterprise effectively.

Unit 1: Entrepreneurship, Creativity & Opportunities

1.1) Concept, Classification & Characteristics and qualities of Entrepreneur

1.2) Creativity and Risk taking.

1.2.1) Concept of Creativity & Qualities of Creative person.

1.2.2) Risk Situation, Types of risk & risk takers.

1.3) Entrepreneurship as a career.

1.3.1) Process of Setting up new Business.

1.3.2) LPG Policy.

1.3.3) Impact of LPG.

1.3.4) Emerging high growth areas.

1.4) Business idea methods and techniques to generate business idea.

1.5) Technical & Financial feasibilities

1.6) SWOT analysis for arriving on product / services.

Unit 2: Information and Support Systems

2.1) Information Needed and Their Sources.

Information related to project, Information related to support system, Information Related to procedures and formalities

2.2) Support Systems: (MCED, NI-MSME, PMEGP, DI, KVIC)

1) Small Scale Business Planning, Requirements.

2) Govt. & Institutional Agencies, Formalities

3) Statutory Requirements and Agencies.

Unit 3: Market Assessment

3.1) Marketing -Concept and Importance

3.2) Market Identification, Survey Key components

3.3) Market Assessment

3.4) Market study process

3.5) Market Segmentation

3.6) Product Life Cycle

Unit 4: Financial Management & Accounting.

Business Finance

4.1) Cost of Project

1) Sources of Finance

2) Types of Capitals

3) Budgeting with (Production Budget with variance report)

4) Profitability

5) Break Even Analysis

6) Financial Ratios and Significance

Business Account (No numerical)

4.2) Accounting Principles, Methodology

1) Book Keeping

2) Financial Statements,

3) Concept of Audit,

Unit 5: Business Plan & Preparation of Project Report

5.1) Business plan steps involved from concept to commissioning

Activity Recourses, Time, Cost

5.2) **Project Report**

1) Meaning and Importance

2) Components of project report/profile **(Give list**)

5.3) **Project Appraisal**

1) Meaning and definition

2) Technical, Financial feasibility

3) Cost benefit Analysis

Unit 6: Enterprise Management and Modern Trends

6.1) **Enterprise Management**: -

1) Essential roles of Entrepreneur in managing enterprise

2) Quality Assurance

3) T.Q.M Total Quality Management

4) Quality Circle

Importance of Quality, Importance of testing

6.2) E-Commerce

1) 5 s and six Sigma

Concept and process

6.3) Global Entrepreneur

List of Assignments:

1. Submit a profile summary of a successful Entrepreneur
2. Generate Business idea Product / service through Brainstorming.
3. Identify business opportunities suitable to you.
4. Survey Industries of your stream; grade them according to level of Production, Investment, turnover, pollution to prepare report on.
5. Visit a bank/financial institution to enquiry about various funding schemes for small scale enterprise.
6. Compile the information from financial agencies that will help you starting up your enterprise.
7. Prepare technical feasibility report of a chosen product/service.
8. Prepare your long term, short term, & long term Goals for starting your enterprise.
9. Prepare marketing strategy for your chosen product / service.
10. Find the Breakeven point for the business idea chosen by you.

Micro Project:

- **Prepare business plan for your chosen small scale Enterprise.**

Course Outcomes:

1. Appreciate the importance of embarking on self-employment and has developed the confidence and personal skills for the same.
2. Identify business opportunities in chosen sector / sub-sector and plan and market and sell products / services.
3. Start a small business enterprise by liaising with different stake holders 4. Effectively manage small business enterprise.

Reference Books:

1. "Entrepreneurial Development" by Khanka S S
2. Entrepreneurial Development and Small Business Management" by Dr. P T Vijayashree & M Alagammai
3. Dynamics of Entrepreneurial Development and Management" by V Desai
4. Business Development for Dummies by Anna Kennedy
5. "Entrepreneurial Development" by Nuzhath Khatoon
6. "Entrepreneurial Development" by Dr C B Gupta and Dr N P Srinivasan.
7. "Entrepreneurial Development" Neerali Prakashan