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Choice Based Credit System (CBCS) in the Light of NEP-2020
Diploma (Solar Engineering)
(w.e.f.A.Y.2023)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
DTSE401	DCC	Design of Solar Cell	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives(CEOs):
The objective of this course is -
1. To know basic of Solar Cell.
2. To understand Semiconductors as basic solar cell material.
3. To understand Concentrators and PV Modules

Course Outcomes(COs):
Upon completion of the course, the student shall be able to
1. To get the knowledge of Solar Cell technologies
2. To comprehend the construction, operations and working of Thin Film Cells.
3. To understand the Concentrators and PV Modules.

Syllabus

UNIT I **10 Hours**

Solar Cell technologies Crystalline Cells: Mono- crystalline and poly – crystalline cells, Metallurgical Grade Si, Electronic Grade Si, wafer production, Mono – crystalline Si Ingots, Poly – crystalline Si Ingots, Si – wafers, Si – sheets, Solar grade Silicon, Si usage in solar PV.

UNIT II **9 Hours**

Commercial Si solar cells, process flow of commercial Si cell technology, process in solar cell technologies, Sawing and surface texturing, diffusion process, thin film layers, Metal contact

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Vishwavidyalaya, Indore	Vishwavidyalaya, Indore		

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DTSE401	DCC	Design of Solar Cell	60	20	20	0	0	3	1	0	4

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UNIT III **10 Hours**

Thin Film Cells: Advantage of thin film, thin film deposition techniques, Evaporation, Sputtering, LPCVD and APCVD, Plasma Enhanced, Hot Wire CVD, closed space sublimation, Ion Assisted Deposition.

UNIT IV **8 Hours**

Semiconductors as basic solar cell material, materials and properties, P – N junction and solar cell. Sources of Losses and prevention, Common Features: Substrate and Super-state configuration, thin film module manufacturing, Amorphous Si Solar cell technology, Cadmium Telluride Cell Technology, CIGS solar Cell.

UNIT V **8 Hours**

Concentrators and PV Modules: Concentration: Advantages and disadvantages, Series Resistance .optimization, Concentrating techniques; tracking / non-tracking systems, Cooling requirements, High concentration solar cells.

References:

1. Solar Electricity Handbook; Michael Boxwell; Greenstream publishing ltd, UK-2011.
2. Solar Power Handbook, Dr. H. Naganagouda (2014)
3. Fundamentals of Renewable Energy Systems Paperback – D. Mukherjee, New Age International Publisher; First edition (2011)
4. Renewable energy Technologies; A Practical Guide for Beginners, Chetan Singh Solanki, PHI School Books (2008).

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DTEE405N	DCC	Fundamentals of Microprocessor	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
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Course Educational Objectives (CEOs):
The objective of this course is to develop an understanding of the operations of microprocessors and machine language programming.

Course Outcomes (COs):
Upon completion of the course, the student shall be able to:
1. Understand and solve digital number system.
2. Recall and apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
3. Analyze the Assembly language programs of 8085.

Syllabus

UNIT-I **9 Hrs.**
Introduction, Block Diagram of a Computer, Von Neuman and Harvard Architecture; **Components:** CPU, Memory, Bus, Input Device, Output Device; Word Length and Data Representation in Microprocessors; **Bus types:** Address Bus, Data Bus, Control Bus,

UNIT-II **8 Hrs.**
Introduction to 8085 Microprocessor: Architecture, Registers organization, ALU, Flag Register, Stack Pointer, Program Counter. Pin Diagram, Pin Description, Timing & Control Signals.
Instruction Cycle & Timing Diagrams: Fetch, Decode, Execute Cycle, Machine Cycle, and T-States.

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DTEE405N	DCC	**Fundamentals of Microprocessor**	60	20	20	30	20	3	0	2	4

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UNIT-III **8 Hrs.**

Memory Organization: Concept of Memory Addressing and Organization, Memory Read/Write operations; **Interfacing Basics**: Interfacing Microprocessors with Memory and I/O Devices. Memory Address Decoding. **Interrupts in 8085:** Interrupt vs Polling, Types of Interrupts and Interrupt Handling Mechanism.

UNIT-IV **8 Hrs.**

Instruction Set of Intel 8085: Instruction format, Types of Instruction, Addressing Modes. **Classification of Instructions:** Data Transfer, Arithmetic, Logical, Branching, and Control Instructions.

UNIT-V **8 Hrs.**

Assembly Language Programming: Writing simple programs for Addition, Subtraction, Multiplication, and Division. Logical Operations: AND, OR, XOR. Looping and Counting Operations. Delay programs, Branching and Conditional Execution.

Textbooks:

1. Fundamentals of Microprocessors & Microcontrollers – By – B. Ram, Revised Seventh Edition,2018.

References:

1. Digital Computer Electronics, Albert P. Malvino & Jerald A. Brown, 3rd edition, 2017.
2. Microprocessor Architecture, Programming & Applications, R. S. Gaonkar, 6th edition, 2013.

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DTEE405N	DCC	Fundamentals of Microprocessor	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

List of Experiments:

1. Write an assembly language program for data transfer among registers.
2. Write an assembly language program for transfer of data from one memory location to another.
3. Write an assembly language program to perform addition and subtraction.
4. Write an assembly language program for division of numbers.
5. Write an assembly language program for multiplication of numbers.
6. Write an assembly language program to perform logical operations
7. Write an assembly language program for generating delay.
8. Write an assembly language program to perform branching operations
9. Write an assembly language program to find the square of a number.
10. Write an assembly language program to perform addition of signed numbers.

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
DTEE305	DCC	Generation Transmission and Distribution	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
The main aim of this course is to understand:

1. Electric power generation from conventional and non-conventional energy source.
2. Analyze the performance of short, medium and long transmission lines.
3. To discuss the operation of HVAC & HVDC transmission, insulator strings, cables and different distribution schemes.

Course Outcomes(COs):
Students will be able to-

1. Understand the importance of non-conventional source of energy and different power plants like solar, wind, tidal, hydro, nuclear, thermal etc.
2. Compare A.C transmission and D.C transmission and derive the expression of transmission line parameters.
3. Determine the equivalent circuits for the transmission lines based on distance and operating voltage for determining voltage regulation and efficiency.
4. Discuss the various insulator materials & their testing and underground cable.
5. Explain the A.C and D.C distribution System and its classification.

Syllabus

UNIT-I **9 Hrs.**

Electric Power Generation

Introduction-Structure of electric power system, Conventional methods of power generations, schematic arrangement, and choice of site for Hydro, thermal, nuclear power plants, General layout & operation, Advantages and Disadvantages, comparison of these power plants.

Non-conventional Energy Source: solar energy its radiation, collection, storage, and application. Wind energy, Biomass energy, geothermal energy, and ocean energy as alternative energy sources.

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DTEE305	DCC	Generation Transmission and Distribution	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

UNIT-II **9 Hrs.**

Electric Power Transmission

AC Transmission: Introduction-Typical Layout of A.C. Power supply scheme various of power Transmission-Advantages and Disadvantages of A.C Transmission.

Transmission Line Parameters: Parameters of single and three phase transmission lines with single and double circuits – Resistance, inductance and capacitance of conductors, skin and proximity effect.

H.V.D.C Transmission: Advantages and Disadvantages of D.C Transmission-Layout Scheme and principle of High Voltage D.C Transmission, Comparison with AC transmission.

UNIT-III **8 Hrs.**

Performance of Transmission Lines: Classification of lines – short line, medium line and long line – equivalent circuits, phasor diagram, real and reactive power flow in lines, transmission efficiency and voltage regulation, simple problems, Ferranti effect., Corona- formation and corona loss-Factors affecting Corona.

UNIT-IV **9 Hrs.**

Line Insulators and Cables: Introduction-Line Insulator Materials-Properties of Insulators-Types, causes of failure of Insulators, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Underground cables – Types of cables, Capacitance of Single-core cable, Grading of cables, Power factor and heating of cables, Capacitance of 3-core belted cable, D.C cables.

UNIT-V **8Hrs.**

Electric Distribution System: Introduction to distribution systems, Different types of supply system and their comparison, DC/AC Distribution system, their types.

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DTEE305	**DCC**	**Generation Transmission and Distribution**	60	20	20	0	0	3	0	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit.
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Textbooks:

1. Leonard L. Grigsby, 'Electric Power Generation, Transmission, and Distribution', CRC Press, 3rd edition, 2012.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

References:

1. Soni, Gupta, Bhatnagar, Electrical Power (Generation, Transmission, Distribution, Protection and Utilization), Dhanpath Rai and Sons, Delhi, 2012.
2. B. R. Gupta, S.Chand, 'Power System Analysis andDesign' New Delhi, Fifth Edition, 2008.
3. C.L. Wadhwa, 'Electrical Power Systems', New Age International Publishers, 8th2022.
4. D. P. Kothari, I.J. Nagarath, 'Power System Engineering', Tata McGraw-Hill Publishing Company Limited, New Delhi, third Edition, 2019.

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DTSE402	DCC	Study of Solar Power Auxiliary Equipments	60	20	20	30	20	3	1	2	5

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***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives(CEOs):
The objective of this course is -

1. To understand Environment concerns of energy extraction.
2. To understand Waste management and pollution control.
3. To understand Environmental protection and carbon credits.

Course Outcomes(COs):
Upon completion of the course, the student shall be able to

1. To get the knowledge of Solar Cell technologies
4. To get the knowledge of Waste management and pollution control.
2. To understand the Concentrators and PV Modules.

Syllabus

UNIT I **9 Hours**

Use of Tools and tackles and safe application practices, a, voltmeter, amp meter, MultiMate, tong tester, AC/DC side testing, Temperature Sensors, monitoring of incoming and outgoing power at junction box & inverter level.

UNIT II **9 Hours**

Inverter: Introduction – evolution of the Inverter- inverter technical specifications and selection – types of Inverters – feature of Inverter, importance of Inverter, compression of inverters, solar inverters.

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DTSE402	DCC	Study of Solar Power Auxiliary Equipments	60	20	20	30	20	3	1	2	5

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UNIT III **9 Hours**

Battery: Typical values of battery voltage, module current & voltage. Acid & their properties, current flow in batteries & impact of shorting of terminals. Charging process & precautions to be taken while charging a battery, Different types of tools & their use

UNIT IV **8 Hours**

Need for personal safety & safety of others. Dangers associated with working at heights. Methods of safety practices while using different hand tools. - Impact of incorrect lifting of objects, system components (especially battery) while installation at heights & while working. - Personal protective equipment& their usage. - Knowledge of the causes of accident & its remedial actions.

References:

1. Solar Photovoltaic; ChetanSinghSolanki; PHI, Learning private ltd., New dehli-02- Oct. 2018.
2. Solar Power Handbook, Dr. H. Naganagouda (2014)
3. Fundamentals of Renewable Energy Systems Paperback – D.Mukherjee, New Age International Publisher; First edition (2011)
4. Renewable energy Technologies; A Practical Guide for Beginners, Chetan Singh Solanki, PHI School Books (2008)

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List of Experiments:

1. To plot the V-I Characteristics of the solar cell and find the solar cell parameters.
2. determine the fill factor.
3. To construct a simple photovoltaic (PV) system, using a PV cell(s) and a DC ammeter, to learn: •
    - How the amount and wavelength of light affect the generation of electricity.
    - How PV systems are connected to produce different voltages and currents.
    - How temperature affects the efficiency of a PV cell.
4. To install a standalone solar PV system for electricity generation.
5. Identify solar panel systems, their components, and technical specifications, as well as calculating the required number of panels and connections for various loads.
6. Perform site selection, Installation, maintenance, and safe operation of solar PV systems.
7. Set the tilt angle of solar panels for maximum efficiency and identify the characteristics of various solar battery types.

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