Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Second Year Bachelor of Engineering

in

Electrical

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



SYLLABUS STRUCTURE

For Affiliated Colleges

Semester – III & IV

W.E.F. 2025 – 26

Syllabus Structure for Second Year Engineering (Semester – III, Level – 5.0) (Electrical) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -301	Electrical Circuit Analysis	PCC	3			3	40	60			100	3
EE -302	Electrical Circuit Analysis Lab	PCC			2	2			25	25 (PR)	50	1
EE -303	Electrical Machines-I	PCC	3			3	40	60			100	3
EE -304	Electrical Machines-I Lab	PCC			2	2			25	25 (PR)	50	1
EE -305	Electrical Workshop Lab	PCC	1		2	3			25	25 (PR)	50	2
EE -306	Biology for Engineers	MD M	2			2	40	60	25		125	2
OE-307	Open Elective – I	OE	3			3	40	60			100	3
EE -308	Knowledge Management	HSSM	2			2						2
EE -309	Universal Human Values	HSSM	1		2	3			25		25	2
EE -310	Community Engagement Project / Field Project	ELC			4	4			50		50	2
			15		**12**	**27**	**160**	**240**	**175**	**75**	**650**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

CA: College Assessment UA: University Assessment

Syllabus Structure for Second Year Engineering (Semester – IV, Level – 5.0) (Electrical) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -401	Electrical Machines-II	PCC	3			3	40	60			100	3
EE -402	Electrical Machines-II Lab	PCC			2	2			25	25 (PR)	50	1
EE -403	Analog and Digital Electronics	PCC	3			3	40	60			100	3
EE -404	Analog and Digital Electronics Lab	PCC			2	2			25	25 (PR)	50	1
EE -405	Electrical Measurement Lab	PCC	1		2	3			25	25 (PR)	50	2
EE -406	Electromagnetic Fields	MD M	2			2	40	60	25		125	2
OE -407	Open Elective – II	OE	3			3	40	60			100	3
EE -408	Maintenance of Electrical Installation	VSEC			2	2			25		25	1
EE -409	Ability Enhancement Course	AEC			2	2			25		25	1
EE -410	Entrepreneurship Development	HSSM	2			2						2
EE -411	Environmental Sciences	HSSM	2			2		25			25	2
			16		**10**	**26**	**160**	**265**	**150**	**75**	**650**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

CA: College Assessment UA: University Assessment

EXIT COURSE FOR U. G. DIPLOMA in Electrical (DURATION 8 WEEKS)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -412	Internship / Apprenticeship	OJT							125			4
EE -413	Mini Project	Project							25			4
									150			8

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COURSE OUTLINE

For Affiliated Colleges

Semester – III

W.E.F. 2025 – 26

ELECTRICAL CIRCUIT ANALYSIS (PCC)					
COURSE OUTLINE					
Course Title:	**ELECTRICAL CIRCUIT ANALYSIS**	**Short Title:**	**ECA**	**Course Code:**	**EE301**

Course description: Introducing the topic and illustrating its importance for electrical engineering field. The concept of magnetic coupling– Analysis of magnetic coupled circuits– Linear transformers– Ideal transformers–Two-port networks and its different equation forms– Evaluation of its parameter– Analysis of terminated two-port circuits– Interconnected two-port networks– Revision and a set of solved examples. Understanding of different types of network theorems. Getting familiar with steady state and transient responses for different types of circuits. Laplace transform and relation between current and voltage for resistance, capacitance and inductance–Laplace transform and Electric circuit sources. Understanding the concepts of two port network.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronics Engineering and Engineering Mathematics

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Provide the student with compression understanding of the basic law of electric circuit & theories.
2. To understand the needs of simplification technique to solve the complicated network.
3. To learn about the use of mathematics, needs of Laplace Transform & usefulness of differential equations for analysis network.
4. Enable students to identify and apply the correct analytical tools for a problem solving and
5. Enhance student's ability to correctly and appropriately interpret and present the analysis result.

Course outcomes:

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

1. Study of magnetic coupling and resonance.
2. Apply network theorems for the analysis of electrical circuits.
3. Justify basic tools to solve circuit design problems.
4. Obtain the transient and steady-state response of electrical circuits.
5. Apply Laplace Transform to analyze dynamic circuit.

<table>
<tr><th colspan="5">COURSE CONTENT</th></tr>
<tr><td colspan="3">ELECTRICAL CIRCUIT ANALYSIS</td><td>Semester:</td><td>III</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="2">Examination scheme</td></tr>
<tr><td>Lectures:</td><td colspan="2">3 hours/week</td><td>End Semester Exam (ESE) UA:</td><td>60 marks</td></tr>
<tr><td colspan="3" rowspan="2"></td><td>Duration of ESE:</td><td>03 hours</td></tr>
<tr><td>Internal Sessional Exam (ISE) CA:</td><td>40 marks</td></tr>
<tr><td colspan="2">Unit–I</td><td>No. of Lectures: 09 Hours</td><td colspan="2">Marks: 12</td></tr>
<tr><td colspan="5">Magnetic Coupling and Resonance: Coupled Circuits: Self inductance and Mutual inductance, Coefficient of coupling, dot convention, Analysis of multi winding coupled circuits, Analysis of single tuned and double tuned coupled circuits. Resonant Circuits: Series and parallel resonance, frequency-response of series and Parallel circuits, Q–Factor, Bandwidth. Topology of networks Concept of duality and dual networks.</td></tr>
<tr><td colspan="2">Unit–II</td><td>No. of Lectures: 09 Hours</td><td colspan="2">Marks: 12</td></tr>
<tr><td colspan="5">Network Theorems: Superposition theorem, Thevenins theorem, Nortons theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and Voltage sources.</td></tr>
<tr><td colspan="2">Unit–III</td><td>No. of Lectures: 09 Hours</td><td colspan="2">Marks: 12</td></tr>
<tr><td colspan="5">Solution of First and Second order networks: Solution of first and second order differential equations for Series and parallel R-L, R-C, RL-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.</td></tr>
<tr><td colspan="2">Unit–IV</td><td>No. of Lectures: 09 Hours</td><td colspan="2">Marks: 12</td></tr>
<tr><td colspan="5">Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Fourier Series and Fourier Transform of Standard Signals.</td></tr>
<tr><td colspan="2">Unit–V</td><td>No. of Lectures: 09 Hours</td><td colspan="2">Marks: 12</td></tr>
<tr><td colspan="5">Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, relationship between parameters, interconnections of two port networks. Concepts of poles and zeros.</td></tr>
<tr><td colspan="5">Text Books:
1. D. Roy Choudhury, “Networks and Systems”, New Age International Publications.
2. A.Chakrabharthy, “Circuit Theory (Analysis and Synthesis)”, Dhanpat Rai and Co.
3. K.V.V. Murthy and M.S.Kamath,“Basic Circuit Analysis”,Jaico Publishers.</td></tr>
<tr><td colspan="5">Reference Books:
1. Franklin F.Kuo,“Network Analysis and Synthesis”,Wiley India,2nd Edition,2008.
2. M.E.VanValkenburg,“NetworkAnalysis”,Prentice Hall,3rd edition, 2006.
3. N.C Jagan,C Lakshminarayan “Electric Circuit Analysis” B.S. Publication , New edition</td></tr>
<tr><td colspan="5">NPTEL Links:
1. Magnet Circuit by Prof. T.K. Bhattacharya, IIT Kharakpur
https://archive.nptel.ac.in/courses/108/105/108105159/
2. Network Theoram by Dr. Nagendra Krishnapura, IIT madras
https://archive.nptel.ac.in/courses/108/106/108106172/
3. Circuit analysis and to port network by Prof. T.K. Bhattacharya, IIT Kharakpur
https://archive.nptel.ac.in/courses/108/105/108105159/</td></tr>
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<table>
<tr><th colspan="5">ELECTRICAL CIRCUIT ANALYSIS LAB (PCC)</th></tr>
<tr><th colspan="5">LAB COURSE CONTENT</th></tr>
<tr><td colspan="2">ELECTRICAL CIRCUIT ANALYSIS LAB</td><td colspan="2">Semester: III</td><td>Course Code: EE302</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="3">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="2">End Semester Exam (ESE) UA: PR</td><td>25 marks</td></tr>
<tr><td colspan="2"></td><td colspan="2">Internal Continuous Assessment (ICA) CA:</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="3">(Practical) PR</td></tr>
<tr><td colspan="5">Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Verification of Thevenins Theorem.
2. Verification of Maximum Power Transfer Theorem.
3. Verification of Superposition Theorem.
4. Verification of Nortons Theorem
5. Pole and Zero plot of one port network.
6. Measurement of hybrid parameter of two port network.
7. Measurement of ABCD parameter of two port network.
8. Measurement of Y parameter of two port network.
9. Measurement of Z parameter of two port network.
10. Frequency response, quality factor and bandwidth of Series Resonance Circuit
11. Frequency response of Parallel Resonance Circuit.</td></tr>
<tr><td colspan="5">Text Books:
1. D. Roy Choudhury, “Networks and Systems”, New Age International Publications.
2. A.Chakrabharthy, “Circuit Theory (Analysis and Synthesis)”, Dhanpat Rai and Co.
3. K.V.V. Murthy and M.S.Kamath,“Basic Circuit Analysis”,Jaico Publishers.</td></tr>
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2. M.E.VanValkenburg,“NetworkAnalysis”,Prentice Hall,3rd edition, 2006.
3. N.C Jagan,C Lakshminarayan “Electric Circuit Analysis” B.S. Publication , New edition</td></tr>
<tr><td colspan="5">Guide lines for ICA:
Students must submit ICA in the form of journal. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.</td></tr>
<tr><td colspan="5">Guide lines for ESE:
ESE will be based on the laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.</td></tr>
</table>

ELECTRICAL MACHINES-I (PCC)

COURSE OUT LINE

Course Title:	ELECTRICAL MACHINES-I	Short Title: EMC-I	Course Code:EE303

Course description:

This course provides knowledge about D. C. machines and transformers to familiarize students with construction, their working, operation, performance and applications of DC machines and Transformer.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understanding on basic principles, construction, and operation of machine and transformer.
2. Identify the classification of machines depend upon construction and working operation
3. Conduct test on different DC machines and Transformer.
4. Correlate the characteristic of DC machines and transformer for different application.
5. Evaluate the performance of DC machines and transformer

Course outcomes:

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

1. Understand fundamental principles of operation and construction for DC machines and transformer.
2. Solve engineering problems of dc motor, dc generator and transformer
3. Identify type of DC machines and transformer.
4. Analyze test data for qualitative and quantitative parameters to determine characteristics of machines and transformer.
5. Evaluate the steady state parameters, basic operating characteristics and performance of DC Machine and transformers for different application.

COURSE CONTENT

ELECTRICAL MACHINES-I		Semester:	III
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I	No. of Lectures: 09 Hours	Marks: 12

DC Generator: Construction of dc machine, Induced emf in an armature coil, lap and wave winding, method of excitation and classification of dc generators, voltage build-up in a shunt generator, critical field resistance and critical speed, armature reaction,. Commutation, characteristics of dc generators,

Unit–II	No. of Lectures: 09 Hours	Marks: 12

DC Motor: DC motor principle and working, back emf, classification of dc motors, torque equation, reaction in dc motor, speed-armature characteristic and speed torque characteristics of motors, armature Power stages, losses and efficiency, Permanent Magnet DC Motor (PMDC)

Unit–III	No. of Lectures: 09 Hours	Marks: 12

DC Motor Control and Testing: Modern starters, Speed control methods, reversal of rotation, Electric Braking methods, Direct load test, Swinburn's test, Hopkinson's Test, Field test on dc series motor

Unit–IV	No. of Lectures: 09 Hours	Marks: 12
Single Phase Transformer: Construction and Principle of operation of single-phase transformers, phasor diagram, equivalent circuit, voltage regulation, losses and efficiency, Effect of change in frequency, condition for maximum efficiency, Testing - open circuit and short circuit tests		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Three-phase Transformer: construction, types of connection and their comparative features, Parallel operation of three-phase transformers, harmonics in magnetization current, Tap-changer on transformers , Scott Connection, Vector group, All Day Efficiency of distribution transformer		

Text Books:

1. Ashfaq Husain, “Electrical Machines”, Dhanpat Rai & Co.
2. B. L. Tharaja, “Course in Electrical Technology, Volume-II,” S Chand Publication.

Reference Books:

1. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
2. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
3. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
4. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
5. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

NPTEL Links:

1. DC Machines by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
2. DC Machines by Prof. D Kastha,IITK
   https://archive.nptel.ac.in/courses/108/105/108105017/
3. Armature reaction by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
4. Speed Control of DC Machine by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
5. Transformer by Prof. G.Bhuvaneshwari, IITD
   https://archive.nptel.ac.in/courses/108/102/108102146/

ELECTRICAL MACHINES-I LAB (PCC)				
LAB COURSE CONTENT				
ELECTRICAL MACHINES-I LAB		**Semester:**	**III**	**Course Code: EE304**
Teaching Scheme:		**Examination scheme**		
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: PR**		**25 marks**
		Internal Continuous Assessment (ICA) CA:		**25 marks**
End Semester Exam (ESE) Pattern:		**(Practical) PR**		

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Determination of magnetization, external , internal characteristics and critical field resistance of d. c. shunt generator
2. Determination of external characteristics of d.c. compound generator as i) differential compound, ii) cumulative compound generator.
3. Speed control of D.C shunt motor by armature and field control.
4. i) Starting of DC motors using 3 and 4 point starters. ii) Reversal of motor rotation of D. C. motor.
5. Determination of performance characteristic of DC series motor by direct load.
6. Swinburne's tests on DC shunt Motor: Determination of losses & efficiency.
7. Polarity and Ratio test on single phase transformer/three phase transformer.
8. Determination of performance of single phase transformer by direct load test.
9. Determination of performance of single phase transformer by conducting Open circuit and short circuit test.
10. Parallel operation of two single phase transformer.
11. Study of phasor and vector group of three phase transformer.
12. Scott connection of two single phase transformer on no load and at balanced load.

Text Books

1. S.G Tarnekar ,P K Kharbanda, "A Text Book on Laboratory Course in Electrical Engineering," S Chand Publication.
2. B. L. Tharaja, "Course in Electrical Technology, Volume-II," S Chand Publication.

Reference Books:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
3. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

Guidelines for ICA:

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Guide lines for ESE:

ESE will be based on the laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

ELECTRICAL WORKSHOP LAB (PCC)					
COURSE OUTLINE					
Course Title:	**ELECTRICAL WORKSHOP LAB**	**Short Title:**	**EWL**	**Course Code:**	**EE 305**

Course description: This course provides the basic practical knowledge about the electrical practice. The course includes the study of different electrical symbols, electrical shocks and safety precautions, equipment used for the measurement and testing of electrical and electronics devices, different types of electronic circuits, The course may include visit to the electrical industries or power plant for the enhancement of practical knowledge

	Hours/week	**No. of**	**Total hours**	**Semester credits**
Theory	1	15	15	**02**
Practical	2	15	30	

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Practical practices used in electrical engineering.
2. Introduction to various tools for measurement and testing of electrical apparatus.
3. Understand the wiring rule , accessory and safety precautions.
4. Understand the type the cable and their current carrying capacity .
5. Understand the layout and equipment of electrical substation

Course outcomes:

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

1. Understand the size and rating of different electrical appliances.
2. Select various measuring instrument based on size of installation and application.
3. Estimate the cable and wiring size for different electrical installation.
4. Justify the safety precaution measure in electrical substation.
5. Recommend the size and type of motor starter based application.

COURSE CONTENT

ELECTRICAL WORKSHOP LAB		**Semester:**	**III**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**1 hour/week**	**End Semester Exam (ESE) UA: PR**	**25 marks**
Practical:	**2 hour/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**
End Semester Exam (ESE) Pattern:		**(Practical) PR**	

Unit–I	**No. of Lectures: 03 Hours**	

Measuring Instrument: DC/AC voltmeter and ammeter, Analog and digital multi-meter for the measurement of electrical quantities, Clip-on meter, Energy Meter, Megger, Power factor meter, Earth tester, Lux meter. Class of accuracy for instrument

Unit–II	**No. of Lectures: 03 Hours**	

Cables and wire: Classification of cable, Cables, Connectors and Switches, Cable standards and specifications, Insulating materials for cables, Cable joining, cable, Different wires, Size selection of wires, Standard wires ,Weather proof wires, Flexible wires.

Unit–III	**No. of Lectures: 03 Hours**	

Wiring Accessories: Types of accessories , Distribution boxes, fuse and MCB boards Domestic wiring and Lamp circuits: Simple circuit, series and parallel circuit, Fluorescent lamp circuits, domestic switch board wiring.

Unit–IV	No. of Lectures: 03 Hours	

Substation equipment: Classification and use of Lightening arrester, Different type of isolators. Substation earthing, Transformer: Standard rating, vector group of power transformer, Standard rating of instrument transformer, Class of accuracy for instrument transformer.

Unit–V	No. of Lectures: 03 Hours	

Starters: Three phase induction motor starter, Study of three phase induction motor reverse forward starter, Contactor, relay and timer circuit, Electronic ballast and fan regulator, Applications of electrical and electronic circuits for domestic and commercial purpose.

LAB COURSE CONTENT

Concerned faculty member should suitably frame **SEVEN** laboratory assignments from the following list.

1. Measurement insulation resistance of cable by Megger,
2. Measurement of Earth resistance by earth tester.
3. Measurement of Illumination level by Lux Meter.
4. Study of different Cables :Classification of cable, and standards and specifications
5. Study of wiring accessories : Types of switches , wire, MCB and MCB DBs.
6. Study of power transformers : Standard rating, vector group of power transformer
7. Study of Instrument transformer: Standard rating of instrument transformer , Class of accuracy
8. Study of Starters: Three phase induction motor starter, Study of three phase induction motor reverse forward starter.
9. Study of Substation equipment: Different insulators, CT/PT, LA
10. Study of different contactor, relay and timer with switching demonstration.
11. Fabrication of any small electrical/electronic circuit for domestic and commercial application
12. Visit to small substation or power control center

Text Books:

1. S. L. Uppal, G. C. Garg, “Electrical Wiring, Estimating and Costing” Khanna Publishers 6 th Edition, 2012

Reference Books:

1. P. P. Gupta, “Maintenance of Electrical Equipments” Dhanpatrai and Sons
2. A. K. Sawhney. “Electrical & Electronic Measurement and Instrumentation” Dhanpant Rai & Co 18th edition, 2007.

NPTEL Link:

1. Transmission line insulators by Prof Subba Reddy B, IISc, Bangalore
   https://archive.nptel.ac.in/courses/108/108/108108116/

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guide lines for ESE:

ESE will be based on the laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

BIOLOGY FOR ENGINEERS (MD M)					
COURSE OUTLINE					
Course Title:	**BIOLOGY FOR ENGINEERS**	**Short Title:**	BFE	**Course Code:**	**EE - 306**

Course description:

This course describes basics and introduction of Biology for various engineering disciplines. It enables students to identify different cell types, functions and biomolecules with their roles. The students were acquainted with the concept of Biomimicry in engineering. After studying the course, student is able to demonstrate the human organ systems and bio-designs.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	02

Course objectives:

Objectives of the course are:
1. To get introduced to different cell types and functions.
2. To understand the biomolecules and their roles.
3. To identify the concept of Biomimicry in engineering.
4. To demonstrate the knowledge of human organ system and bio-designs.
5. To analyze Bioengineering concepts.

Course outcomes:

After successful completion of this course the student will be able to:
1. Identify cell types and their functions and chemistry of cells.
2. Understand Biomolecules with their applications.
3. Identification & applications of Biomimicry in engineering.
4. Correlate the human organ system and bio-designs.
5. Analyze Bioengineering concepts and their applications across different engineering disciplines.

COURSE CONTENT

BIOLOGY FOR ENGINEERS		**Semester:**	**III**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**2 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**
		Internal Continuous Assessment (ICA) CA:	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**	**Marks: 12**

Introduction to Biology: The cell: the basics of a cell. Prokaryotic and Eukaryotic cell, The Plant Cell and animal cell, Chemistry of cells. Cell Division: Cell cycle, mitosis, meiosis, cell division, cell cycle check points, cell death.

Unit–II:	**No. of Lectures: 06 Hours**	**Marks: 12**

Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Application of Biomolecules in water filters production, Proteins in food production, lipids in biodiesel and detergents production, Enzymes in biosensors fabrication, food processing

Unit–III:	**No. of Lectures: 06 Hours**	**Marks: 12**

Biomimicry: Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

Unit–IV:	**No. of Lectures: 06 Hours**	**Marks: 12**
Human Organ Systems and Bio Designs: Brain as a CPU system (signal transmission, BCI, EEG). Eye as a Camera system (rod and cone cells, optical corrections, lens materials, bionic eye). Heart as a pump system (electrical signaling - ECG monitoring, design of stents, pacemakers, defibrillators). Lungs as purification system (spirometry, Ventilators, Heart-lung machine, artificial lungs). Kidney as a filtration system.		
Unit–V:	**No. of Lectures: 06 Hours**	**Marks: 12**
Bioengineering: Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis.		
Text Books:		
1. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012. 2. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011 3. Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023		
Reference Books:		
1. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press. 2. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008 3. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016. 4. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016 5. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000). Lehninger principles of biochemistry. New York: Worth Publishers.		
NPTEL Links:		
NPTEL Course on Biology for engineers and other non-biologists (4 weeks UG Course) By Prof. G.K. Suraish kumar & Prof. Madhulika Dixit (IIT. Madras)		
Guidelines for ICA:		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

KNOWLEDGE MANAGEMENT (HSSM)					
COURSE OUTLINE					
Course Title:	**KNOWLEDGE MANAGEMENT**	**Short Title:**	KM	**Course Code:**	**EE 308**

Course description:
The course explores concepts of management and functioning of organizations. It introduces both theoretical concepts and empirical applications, focusing particularly on production industries. Management studies have influenced every aspect of business thinking and planning. Apart from this, it also influenced our day-today lives in the form of technological advancements. The syllabus explores the knowledge of principle of management, financial management, human resource management, operational management and marketing management.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	**02**

Prerequisite course(s):

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand fundamental concepts of management,
2. Understand the processes and behavioral dynamics in organizations.
3. Explain recent developments in business in the context of economic theory.
4. Understand the concepts, philosophies, and processes of managing the marketing & financial operations of a firm.

Course outcomes:

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

1. Interpret various concepts of Management.
2. Understand terms related to Economics of Industrial Management
3. Illustrate different plant layouts and terms related to Operational Management
4. Describe concepts of Human Resource Management and laws related to industries.
5. Understand basic concepts of Marketing and Financial Management.

COURSE CONTENT

Knowledge Management		**Semester:**	**III**
Teaching Scheme:			
Lectures:	**2 hours/week**		

Unit–I	**No. of Lectures: 06 Hours**	

Principles of Management: Basic Concepts: Definition, Nature, Importance, Management: Art and Science & as a Profession, Management Vs Administration, Evolution of Management: Introduction to Scientific Management by Taylor, Administrative, Management by Fayol, Contribution of Peter Drucker, Levels & Functions of Management, Forms of Business Organization. Organization: Formal & Informal, Line & Staff relationship, Centralization vs. Decentralization, Span of Management, Departmentation, MBO.

Unit–II	**No. of Lectures: 06 Hours**	

Managerial Economics: Introduction: Meaning & Scope of Economics, Basic Theories, Law of Demand & Supply, Elasticity of Demand & Supply. Consumer Theories: Meaning of Utility & Law of Diminishing Utility.Cost Concepts: Opportunity Costs, Sunk Costs, Marginal Cost, Total & Variable Costs, Fixed Costs, Contribution, Law of Diminishing Return.

Unit–III	No. of Lectures: 06 Hours	
Operational Management: Plant location and layout: Factor affecting plant location, different type of plant layout, CPM PERT, quality control manufacturing system, store and inventory control Work study – techniques of work study method study, work measurement, different charts and diagrams used in method study		
Unit–IV	**No. of Lectures: 06 Hours**	
Human Resource Management: Human resource planning, Recruitment, Selection, Placement & Induction, Performance Appraisal & Development, Employee Training, Internal & External Mobility & Retention Management, Wage & Salary Administration, Fringe Benefits & Incentives Payments, Collective Bargaining, Performance appraisal , compensation Industrial Laws: The factories Act 1947, The Workmen's Compensation Act 1923, Maternity Benefit Act The Payment of Wages Act 1936, The Apprentices Act 1961, industrial safety, prevention of accidents pollution control act		
Unit–V	**No. of Lectures: 06 Hours**	
Marketing Management & Financial Management : Introduction to Marketing: Concept of Market, Types of Market, Definition, Nature & Scope of Marketing, Marketing Approaches, Marketing Process, Functions of Marketing Management, 7 P"s of Marketing. Advertising media of advertising market forecasting. New trends in Marketing: Green Marketing, e- marketing & Viral Marketing. Introduction to Financial Management: Meaning, Nature & Scope of Financial Management, Capital Structure, Types & Sources of Finance, Money Market & Capital Market, Role of Financial Institutions in Industry.		
Text Books:		
1. P. Khanna, "Industrial Engineering Managements" 2. S. S. Khanka "Human resource Management (Text & Cases)" S. Chand publication, 2003.		
Reference Books: 1. L. M. Prasad, "Principles of Management", Himalaya Publications House, 1st edition, 2014. 2. D. N. Dwivedi, "Managerial Economics", Vikas Publications, 8th edition, 2015. 3. P. Subba Rao "Essentials of HRM & IR" (Text, Cases & Games), Himalaya Publishing House, 5th edition. 4. R. S. N. Pillai, V. Bagavathi, "Legal Aspects of Business" (Mercantile Laws including Industrial & Company Laws), 2011. 5. Philip Kotler, "Marketing Management", Tata McGraw Hill, 12th edition. 6. Ravi M. Kishor, "Financial Management", Taxmann Publication, 2nd edition, 2011.		
NPTEL Links: 1. Principles of ManagementBy Prof. Usha Lenka IIT Roorkee https://onlinecourses.nptel.ac.in/noc25_mg52/preview		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

UNIVERSAL HUMAN VALUES (HSSM)					
COURSE OUTLINE					
Course Title:	**UNIVERSAL HUMAN VALUES**	**Short Title:**	**UHV**	**Course Code:**	**EE - 309**

Course description:

Today, education has become more and more skill biased, and hence, the basic aspiration of a human being, that is to live with happiness and prosperity, gets defeated, in spite of abundant technological progress. This course is aimed at giving inputs that will help to ensure the right understanding and right feelings in the students in their life and profession, enabling them to lead an ethical life. In this course, the students learn the process of self-exploration, the difference between the Self and the Body, the naturally acceptable feelings in relationships in a family, workplace and society, the comprehensive human goal in the society, the mutual fulfilment in the nature and the co-existence in existence. As a natural outcome of such inputs, they are able to evaluate an ethical life and profession ahead.

Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	01	15	15	02
Practical	02	15	30	

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course outcomes:

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

1. Become more aware of themselves, and their surroundings (family, society, nature);
2. Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.
4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning will be made in this direction.

COURSE CONTENT

UNIVERSAL HUMAN VALUES		**Semester:**	**III**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**1 hour/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**
Practical:	**2 hours/week**		

Unit–I:	**No. of Lectures: 03 Hours**	
Introduction to Value Education		
Understanding Value Education Self-exploration as the Process for Value Education Basic Human Aspirations and their Fulfilment Right Understanding, Relationship and Physical Facility Happiness and Prosperity – Current Scenario Method to Fulfil the Basic Human Aspirations		
Unit–II:	**No. of Lectures: 03 Hours**	
Harmony in the Human Being		
Understanding the Human Being as Co-existence of the Self and the Body Distinguishing between the Needs of the Self and the Body The Body as an Instrument of the Self Understanding Harmony in the Self Harmony of the Self with the Body Programme to Ensure Self-regulation and Health		
Unit–III:	**No. of Lectures: 03 Hours**	
Harmony in the Family and Society		
Understanding Harmony in the Family – The Basic Unit of Human Interaction 'Trust' – The Foundational Value in Relationship Respect – As the Right Evaluation Other Values in Human-to-Human Relationship Understanding Harmony in the Society Vision for the Universal Human Order		
Unit–IV:	**No. of Lectures: 03 Hours**	
Harmony in the Nature (Existence)		
Understanding Harmony in Nature Interconnectedness, Self-regulation and Mutual Fulfilment among the Four Orders of Nature Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence		
Unit–V:	**No. of Lectures: 03 Hours**	
Implications of the Holistic Understanding – A Look at Professional Ethics		
Basis for Universal Human Values Definitiveness of (Ethical) Human Conduct Professional Ethics in the Light of Right Understanding A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order Holistic Technologies, Production Systems and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession		
Text Books:		
1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 3rd Revised Edition, UHV Publications, 2023. 2. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics – Teachers Manual, 3rd Revised Edition, UHV Publications, 2023 3. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022. 4. UHV-II: Universal Human Values: Understanding Harmony and Ethical Human Conduct https://fdp-si.aicte-india.org/UHVII.php		

5. https://uhv.org.in/uhve

Reference Books:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Reports, Papers and Impact Studies on UHV Implementation,
    a. https://drive.google.com/drive/folders/1N_1Z1tIm8-iDfy9nQRcHbs_Bjtrk_d24
    b. https://fdp-si.aicte-india.org/Activity_and_Impact.php

Video Links:

1. About UHV Refresher for UHV-II – English, https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So
2. https://www.youtube.com/playlist?list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz

Guide lines for ICA:

Students must submit ICA in the form of journal with **FIVE** assignments / activities based on the practice sessions outlined in the Teacher's Manual (Text Book No. 2, https://uhv.org.in/frontend/download/Teachers%20Manual%20Foundation%20Course%20in%20Human%20Values%20and%20Professional%20Ethics%20(eBook).pdf), encompassing a process of self-investigation and self-exploration, suitably framed by concerned teacher / faculty mentor.

The assessment, in this course, is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. shall be used in evaluation. The evaluation criteria for assessment are as follows.

Assessment by Teacher / faculty mentor: 05 marks
Self-assessment: 05 marks
Assessment by peers: 05 marks
Socially relevant project/Group Activities/Assignments: 10 marks

Faculty in charge will assess the assignments continuously and grade or mark each assignment / activity on completion date declared for each assignment / activity.

COMMUNITY ENGAGEMENT PROJECT / FIELD PROJECT					
COURSE OUTLINE					
Course Title:	**COMMUNITY ENGAGEMENT PROJECT / FIELD PROJECT**	**Short Title:**	**CEP**	**Course Code:**	**EE - 310**

Course description:
The subject Community Engagement Project / Field Project involves activities that will expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	04	15	60	02

Prerequisite course(s):

Course objectives:

The objective of this course is to:
1. To develop an appreciation of rural culture, life-style and wisdom amongst students
2. To learn about the status of various agricultural and development programmes
3. To understand causes for distress and poverty faced by vulnerable households and explore solutions for the same
4. To apply classroom knowledge of courses to field realities and thereby improve quality of learning

Course outcomes:

After successful completion of this course the student will be able to:
1. Gain an understanding of rural life, Indian culture & ethos and social realities
2. Develop a sense of empathy and bonds of mutuality with local community
3. Appreciate significant contributions of local communities to Indian society and economy
4. Learn to value the local knowledge and wisdom of the community
5. Identify opportunities for contributing to community's socio-economic improvements

COURSE CONTENT

COMMUNITY ENGAGEMENT PROJECT / FIELD PROJECT		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**50 marks**

The course requires students to participate in any **TWO** field-based learning/projects as listed below under the supervision of faculty. This will help educate local communities about new technological innovations as well as aware students about ways to harness local technology and knowledge. In this approach, students apply their knowledge and skills in a chosen community to improve the lives of people in that community. The activities may also be conducted other than working hours.

Recommended field-based activities (Tentative):

1. Interaction with Self Help Groups (SHGs) women members, and study of their functions and challenges; planning for their skill building and livelihood activities
2. Visit Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGS) project sites, interact with beneficiaries and interview functionaries at the work site
3. Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures

4. Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan (GPDP)
5. Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
6. Visit Rural Schools / mid-day meal centres, study academic and infrastructural resources and gaps
7. Participate in Gram Sabha meetings, and study community participation
8. Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
9. Visit to local Nagarpalika office and review schemes for urban informal workers and migrants
10. Attend Parent Teacher Association meetings, and interview school drop outs
11. Visit local Anganwadi Centre and observe the services being provided
12. Visit local NGOs, civil society organisations and interact with their staff and beneficiaries,
13. Organize awareness programmes, health camps, Disability camps and cleanliness camps
14. Aware / conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys and guiding solar powered village
15. Raise understanding of people's impacts of climate change, building up community's disaster preparedness
16. Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
17. Formation of committees for common property resource management, village pond maintenance and fishing
18. Identifying the small business ideas for rural areas to make the people self-reliant.
19. Undertaking research projects in partnership with local community through community-based research methods
20. Social innovation projects with a social impact
21. Financial Literacy Awareness Programme
22. Digital Literacy Awareness Programme
23. Education Loan Awareness Programme
24. Entrepreneurship Awareness Programme
25. Awareness Programmes on Government Schemes
26. Products Market Awareness
27. Services Market Awareness
28. Consumer Awareness Programme
29. Accounting Awareness Programme for Farmers
30. Accounting Awareness Programme for Street Vendors etc.
31. Nutrition survey for mothers and children, and educate them about hygiene and nutrition.
32. Study / Survey / Field based Project on contributions / implications / influence / impact of Indian Knowledge System on Indian Society / Community / life / values / practices / principles / technology / development etc.

Students must conduct comprehensive studies on various challenges that they face in their chosen field. Every work relevant to the subject matter should be compiled and documented.

Students should keep separate fieldwork diary or maintain journal in order to record their fieldwork experiences i.e. reading, e- contents, tasks, planning and work hours have to be recorded in the diary. Detailed work records report on students' fieldwork experiences and activities to be submitted and should be presented.

Every student shall submit a report in the form of journal that may include, but not limited to, the following.

1. A map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village / community.
2. Videos and/or Geo-tagged photographs of events / activities conducted
3. Describe your analysis of rural household economy, its challenges and possible pathways to address them
4. How effectively are institutions functioning? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual).
5. Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving implementation of the programme for the community.

Guide lines for ICA:

Students must submit ICA in the form of journal. Faculty in charge will monitor and assess continuously with grade or mark each project on completion date declared for each of them.

Assessments of students shall include review of their involvement and contributions to community engagement. It shall also include presentation of project findings as documented in the journal.

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Second Year Bachelor of Engineering

in

(Common for all)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE FOR OPEN ELECTIVE - I

For Affiliated Colleges

Semester – III

W.E.F. 2025 – 26

Open Elective – I

A Student can opt for any one subject out of available institute wide subjects defined in the following list as Open Elective provided, he/she has not taken that particular subject in his/her Programme core, Programme elective, Multidisciplinary Minor, other Open elective and Vocational and Skill Enhancement courses etc. throughout his / her four years of UG Engineering Programme. The student must opt a subject that is compulsorily from faculty other than that of the Major discipline.

Course Code	Name of the Subject / Course	Faculty Offered by	Department Offered by
Open Elective - I (w.e.f. 2025 - 26 at Semester - III, Second Year Engineering)			
OE – 307 A	Quantitative Reasoning and Problem Solving	Sci. & Tech.	Mathematics
OE – 307 B	Management Science	Comm. & Mgmt.	Management
OE – 307 C	Business Ethics & Professional Values	Comm. & Mgmt.	Management
OE – 307 D	Plant Nursery and Management	Sci. & Tech.	Botany
OE – 307 E	General Clinical Pathology	Sci. & Tech.	Biochemistry
OE – 307 F	Herbal Home Remedies	Sci. & Tech.	Botany
OE – 307 G	Psychology of Well-being	Humanities	Psychology
OE – 307 H	Fundamentals of Banking	Humanities	Economics

QUANTITATIVE REASONING AND PROBLEM SOLVING (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**QUANTITATIVE REASONING & PROBLEM SOLVING**	**Short Title:**	**QRPS**	**Course Code:**	**OE - 307 A**
Course description:					
The Quantitative Reasoning course is designed to develop a student's ability to understand, analyze, and apply mathematical concepts and reasoning techniques to solve real-world problems. The course emphasizes critical thinking and logical analysis, focusing on the interpretation and manipulation of quantitative data.					

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. Use appropriate mathematical and statistical language in oral, written, and graphical forms.
2. Think critically about mathematical models for relationships between different quantities and use those models effectively and accurately to solve problems and reach sound conclusions about them.
3. Interpret and analyze various representations of data.

Course outcomes:

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

1. Perform arithmetic calculations on number system, HCF and LCM and age
2. Solve application problems involving Time, Distance, Speed.
3. Calculate the time required to do the work and fill the cistern.
4. Calculate problems based on percentage, average and simple interest.
5. Analyze and interpret data using statistical techniques

COURSE CONTENT

QUANTITATIVE REASONING AND PROBLEM SOLVING		**Semester:**	**III**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of EE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Number System: Fundamental Concepts, Tests of Divisibility, Factorial of number, Modulus of a number, Greatest integral Value, Multiplication by Short cut method, Division algorithm.
Highest Common Factor and Least Common Factor: Factors and Multiples, Factorization method, Division Method, HCF and LCM of fractions, HCF and LCM of decimal Fractions. **Problems on Ages** : Ratio Based Age Problems, Equation Solving Type Age Problems, Finding Ratio Between Ages.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Time and Distance: Unit Conversion Time and Distance Problems, Average Speed When Travelling To A Place And Returning, Problems Based On Changing Time And Changing Speed.

Problem on Trains: Important facts and Formulae, Time taken by train to pass pole/standing man / Signal post, relative Speed of trains/ bodies moving in same direction, cross time of trains/bodies moving in opposite direction, Cross time trains/ bodies moving in same direction with different speed, reaching time of two trains/ bodies start at the same time from point A and B towards each other destination.

Problem on Boat: Speed of downstream, Speed of upstream, Speed in still water, Rate of stream, Speed of the man in still water.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Time and Work: Calculate Time to Complete Work by 2 or More People, Equations Based Time and Work Problems, Efficiency Based Time and Work Problems, Calculate Time When Efficiency is Given in Percentage, Calculate Time When Workers Leave in Between, Share of Salary Based on Work**.**

Pipes and Cisterns: Important Facts and Formulae, Calculate Time Taken to Fill a Tank By 2 or More Pipes, Calculate Time Taken to Fill a Tank with Leakage, Equations Based Pipes and Cistern Problems, Calculate Time Taken When Pipes Are Opened for Different Periods, Calculate Number of Pipes.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Percentage: Concepts of percentage, Results on population, Result on depreciation, Salary Comparison percentage problems, Appreciation and depreciation based Percentage problems, Price and consumption based percentage problems

Average: Number Series Summation based Averages, Consecutive Even/Odd Type Problems, Distance and Speed based Averages.

Simple Interest: Important Fact and Formulae, Simple Interest Formula based Direct Problems, **Compound Interest** Formula based Direct Problems

Ratio and Proportion : Combined Ratio Based on Individual Ratios, Distributing any Quantity Based on Ratios, Coins Based Ratio Problems, Mixtures & Replacement Based Ratio Problems

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Clocks: Finding angle between Minute and Hour Hands, Finding Time if angle is given, Correct Time on incorrect (Fast or Slow) Clocks.

Calendar: Odd day, Leap year, Ordinary Year, Counting of Odd days, Day of the week related to odd days.

Data Interpretation: Tabulation, Bar Graph, Pie Chart, Line graph, Problem on data Interpretation: Sum and Difference based, Average based questions, percentage-based questions.

Text Books:

1. Dr. R.S. Aggarwal “Quantitative Aptitude” S. Chand Publication, Revised Edition 2017

MANAGEMENT SCIENCE (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**MANAGEMENT SCIENCE**	**Short Title:**	MS	**Course Code:**	**OE – 307 B**

Course description:

This course provides students with a fundamental understanding of Management Science, covering key concepts such as decision-making, organizational structure, operations and process management, project management, and modern management practices. The course focuses on essential management functions, managerial skills, quality control techniques, inventory management, and project planning tools like PERT and CPM. It aims to develop students' analytical and problem-solving skills, preparing them for effective decision-making and managerial roles in various industries.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	03

Prerequisite course(s):

Principles of Management, Quantitative Techniques for Management, Operations Management, Project Planning and Control and Business Analytics

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. To understand the fundamental principles and functions of management and their historical evolution.
2. To analyse organizational structures and evaluate their impact on business efficiency.
3. To apply quality management techniques and inventory control methods for process optimization.
4. To utilize network analysis techniques like PERT and CPM for project planning and management.
5. To implement modern management practices such as ERP, JIT, TQM, and Six Sigma for continuous improvement.

Course outcomes:

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

1. Explain core management concepts and their relevance in organizational success.
2. Evaluate and implement appropriate organizational structures based on business needs.
3. Apply inventory and quality management techniques to optimize business processes.
4. Demonstrate the use of project management tools for effective planning and execution.
5. Implement modern management methodologies such as Kaizen, Kanban, and Lean Manufacturing to improve organizational performance.

COURSE CONTENT

MANAGEMENT SCIENCE		Semester:	III
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Fundamentals of Management

Definitions, Nature, Importance, and Functions of Management
Historical Perspectives: Evolution of Management Thought
Levels of Management and their Functions
Decision-Making Types & Process

Managerial Skills and Roles (Mintzberg's)

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Organization and Structure

Concepts and Principles of Organization
Formal and Informal Organization, Authority, Responsibility, Delegation
Types of Organizational Structures: Line, Line and Staff, Matrix, and Team Structures
Departmentation: Need, Importance, and Bases of Departmentation

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Operations and Process Management

Fundamentals of Work Study: Time and Motion Study Techniques
Quality Management: Tools and Techniques (P-Chart, R-Chart, C-Chart)
Inventory and Material Management:
Importance of Inventory Control
Economic Order Quantity (EOQ) Calculation
ABC Analysis and its Variants (HML, SDE, VED, FSN)

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Project Management

Introduction to Project Management: Objectives and Importance
Network Analysis: Concepts and Applications
PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method): Comparison and Implementation
Project Optimization: Cost-Time Trade-Off and Crashing Techniques

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Modern Management Practices

Materials Requirement Planning (MRP) and Enterprise Resource Planning (ERP)
Just-In-Time (JIT) and Lean Manufacturing
Total Quality Management (TQM): Principles and Implementation
Six Sigma: Concepts and DMAIC Process
Japanese Management Practices: Kaizen, Kanban, and 5S

Text Books:

1. Essentials of Management by Harold Koontz & Heinz Weihrich, 6th Edition, Tata McGraw-Hill (2005)

Reference Books:

1. Koontz & Weihrich: Essentials of Management, 6/e, TMII, 2005
2. Kanishka Bedi: Production and Operations Management, Oxford University Press, 2004
3. Samuel C. Certo: Modern Management, Pearson Education, 2005
4. Mahajan, M. (2015). Industrial engineering and production management. Dhanpat Rai & Co. (P) Limited.

NPTEL Links:

1. Principles of Management by Prof. Usha Linka
   https://archive.nptel.ac.in/courses/110/107/110107150/
2. Production and Operation Management by Prof. Rajat Agrawal
   https://archive.nptel.ac.in/courses/110/107/110107141/
3. Economic Order Quantity by Prof. Puran Singh
   https://www.youtube.com/watch?v=_h4i9C47rT8
4. Total Quality Management by Prof. Raghunandan Sengupta
   https://archive.nptel.ac.in/courses/110/104/110104080/

BUSINESS ETHICS & PROFESSIONAL VALUES (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**BUSINESS ETHICS & PROFESSIONAL VALUES**	**Short Title:**	BE&PV	**Course Code:**	**OE – 307 C**

Course description:

This course provides students with a fundamental understanding of business ethics and professional values, focusing on ethical decision-making, corporate governance, workplace ethics, and corporate social responsibility (CSR). It explores ethical leadership, environmental sustainability, and the ethical challenges posed by emerging technologies.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand the principles and significance of business ethics in organizational success.
2. Analyse ethical theories and decision-making models in corporate environments.
3. Evaluate corporate governance, ethical leadership, and workplace ethics.
4. Explore ethical challenges in technology, globalization, and sustainability.
5. Develop a strong foundation in professional values and responsible business conduct.

Course outcomes:

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

1. Apply ethical principles and decision-making frameworks in business scenarios.
2. Assess the role of corporate governance and ethical leadership in business success.
3. Analyse workplace ethics and strategies for ethical corporate culture.
4. Evaluate ethical considerations in technology, cyber security, and sustainability.
5. Demonstrate professional values such as integrity, accountability, and transparency in decision-making.

COURSE CONTENT

BUSINESS ETHICS & PROFESSIONAL VALUES		Semester:	III
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Fundamentals of Business Ethics

Definition, significance, and principles of business ethics
Ethical theories: Utilitarianism, Deontology, Virtue Ethics
Ethical decision-making models: Consequentialist, Non-consequentialist and Hybrid Approaches
Role and importance of ethics in achieving organizational goals
Corporate Governance and Ethical Business Practices
Ethical dimensions of corporate social responsibility (CSR)

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Ethical Leadership and Workplace Practices

Key aspects: Workplace ethics, confidentiality, and transparency
Ethical leadership: Traits, decision-making, and influence on organizational culture

Technology ethics: Privacy, cybersecurity, and AI-related challenges
Addressing dilemmas: Whistleblowing, conflicts of interest, and ethical challenges
Diversity, equity, and inclusion (DEI) in ethical decision-making
Corporate fraud and unethical business practices: Causes, consequences and Preventive measures

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Emerging Ethical Challenges and Trends

Ethical considerations in disruptive technologies: AI, blockchain, IoT, and robotics
Intellectual property rights (IPR): Significance and ethical dimensions of innovation
Ethical challenges in globalization: Cultural relativism and navigating cross-border practices
Future trends: Sustainable leadership, stakeholder capitalism, and Industry 4.0
Environmental ethics in business: Carbon footprint reduction, sustainable resource management and corporate environmental responsibility
Cyber security and ethical hacking: Digital ethics, protection against cybercrimes, ethical dilemmas in surveillance, and hacking ethics

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Environmental and Sustainability Ethics

Organizational responsibilities for health, safety, and the environment
Green engineering: Sustainable designs and renewable technologies
Case studies: Lessons from environmental disasters (e.g., Bhopal Gas Tragedy, Exxon Valdez oil spill), Regulatory frameworks: Environmental laws, compliance, and ethical practices
Climate change and corporate responsibility: Strategies for sustainable business operations
Role of businesses in achieving Sustainable Development Goals (SDGs)

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Professional Values

Definition and relevance of professional values
Core values: Honesty, integrity, accountability, transparency, and respect
Workplace ethics: Building an ethical culture and promoting positive work environments
Professional codes of conduct: ASME, ASCE, IEEE, IETE
Business etiquette and ethical decision-making in professional interactions,
Role of mentorship and leadership in cultivating professional values

Text Books:

1. "Business ethics: Concepts and cases (9th ed.)" by Velasquez, M. G. (2020) Pearson.

Reference Books:

1. Crane, A., Matten, D., Glozer, S., & Spence, L. J. (2019). Business ethics: Managing corporate citizenship and sustainability in the age of globalization (5th ed.). Oxford University Press.
2. Fernando, A. C. (2019). Business ethics: An Indian perspective (4th ed.). Pearson Education India.
3. Saha, B. (2010). Environmental ethics: A practical approach. Aadi Publications.
4. Johnson, D. G., & Wetmore, J. M. (2008). Technology and society: Building our sociotechnical future. MIT Press.

NPTEL Links:

1. Business Ethics by Prof Susmita Mukhopadhyay
   https://archive.nptel.ac.in/courses/110/105/110105079/
2. Intellectual property rights By Dr. K. D. Raju
   https://archive.nptel.ac.in/courses/110/105/110105139/
3. Ethics in Engineering Practice by Prof Susmita Mukhopadhyay
   https://archive.nptel.ac.in/courses/110/105/110105097/
4. Introduction to Industry 4 0 and Industrial Internet of Things by a Prof. Sudip Misra
   https://archive.nptel.ac.in/courses/106/105/106105195/

PLANT NURSERY AND MANAGEMENT (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**PLANT NURSERY AND MANAGEMENT**	**Short Title:**	**PNM**	**Course Code:**	**OE – 307 D**

Course description:

This course is designed to provide students with an in-depth understanding of the processes, practices, and techniques involved in the establishment and management of plant nurseries. It covers various aspects of plant production, from seedling propagation to the management of nursery operations. Students will gain practical knowledge in selecting plant species, propagating plants, maintaining nursery health, and understanding the financial and operational considerations in managing a nursery.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	03

Prerequisite course(s):

Course objectives:

1. To provide knowledge about basic concepts and principles of nursery techniques.
2. To impart basic and technical knowledge on nursery management for strengthening of horticulture sector.
3. To study the disease and pest controlling nursery with practical experience.
4. To help students to study marketing and management relating to nursery.
5. To help students to manage nurseries and propagate healthy plants on a commercial scale.

Course outcomes:

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

1. Understand the importance of a plant nursery and basic infrastructure to establish it.
2. Explain the basic material, tools and techniques required for nursery.
3. Demonstrate expertise related to various practices in a nursery.
4. Comprehensive knowledge and skills to get an employment or to become an entrepreneur in plant nursery sector.
5. To know green house and playhouse technology.

COURSE CONTENT

PLANT NURSERY AND MANAGEMENT		Semester:	III
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Plant nursery:

Introduction, definition and importance. Types of nurseries, Temporary (Features, Advantages and disadvantages).Permanent (Features, Advantages and disadvantages.) Ornamental, Vegetable, Fruit plant, Forest plant, Open field and High-tech nurseries. Selection of place, lay out and components of a good nursery. Important role of nursery in horticulture development.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Nursery Basic requirement and setup:

Nursery beds–types and precautions to be taken during preparation. Growing media, nursery tools and implements, and containers in brief. Soil and seed treatments sowing of seeds and planting material used for nursery.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Plant Propagation Technique:

Introduction, Sexual propagation (Advantages and dis-advantages) Cutting (Root, Stem and leaf cutting) Layering (Simple and Air layering) (Gootee) Budding (T and Patch budding)Grafting (Whip and tongue grafting). Green house and Polyhouse Types and importance.

Unit-IV:	No. of Lectures: 09 Hours	Marks: 12

Nursery Management practices:

Potting and repotting, application of manures and fertilizers. Plant bio-regulators and growth retardants, Water quality and management. Common diseases, pests, care and management of nursery plants. Seasonal activities and routine operations in a nursery. Common possible errors in nursery activity. Bureau of Indian Standards (BIS-2008) related to nursery. Economics of nursery development, pricing and record maintenance. Packing, transport, Branding and marketing of nursery plants. Entrepreneurship development through nursery.

Unit-V:	No. of Lectures: 09 Hours	Marks: 12

Vertical farming and Hydroponics:

Vertical Farming: Introduction, scope and importance. Plants suitable for vertical farming. Advantages of vertical farming. Hydroponics: Introduction, scope and importance. Basic concepts and designs, Importance of light, temperature and humidity. Nutrient film technique (NFT) Advantages and Plants suitable for hydroponics.

Text Books:

1. "Plant Nursery Management: Principles and Practices, Central Arid Zone Research Institute" by Ratha Krishnan, P. Kalia Rajwant K.Tewari, J.C., Roy M.M., (2014).

Reference Books:

1. Bose, T.K. Sanyal, Dand Sandhu, M.L. (1998) Propagation of Horticultural crops. Naya Prakash Publishers, Kolkatta.
2. K.K. Nanda and V.K. Kochhar (1985). Vegetative propagation of plants. Kalyani Publisher-NewDelhi-Ludhiana.
3. Kunte, Y.N.,Kawthalkar, M.P.andYawalkar,K.S.(2005).Principles of Horticulture and Fruit Growing. Agri-Horticultural Publishing House, Nagpur.
4. Rahudkar W.B., Bhujbal B.G.,Madhuri Sonawane, Hemraj Rajput ,(2010), CMOU, Text book Publication No. AGR 227Horticulture Nursery Management.
5. Randhawa G.S., A. Mukhopadhyay (2001). Floriculture in India. Book published by Allied Publishers Limited, New Delhi

NPTEL Links:

1. Basics of Crop Breeding and Plant Biotechnology (https://onlinecourses.nptel.ac.in/noc25_ag01/preview)
2. Plant Developmental Biology By Prof. Shri Ram Yadav | IIT Roorkee (Plant Developmental Biology - Course (nptel.ac.in))

GENERAL CLINICAL PATHOLOGY (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**GENERAL CLINICAL PATHOLOGY**	**Short Title:**	GCP	**Course Code:**	**OE - 307 E**
Clinical pathology is the second major subdivision of the discipline of pathology after anatomic pathology. It is concerned with laboratory investigations for screening, diagnosis, and overall management of diseases by analysis of blood, urine, body fluids, and other specimens. The specialties included under the discipline of clinical pathology are clinical chemistry, hematology, blood banking, medical microbiology, cytogenetics and molecular genetics.					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To study the basic principles of laboratory medicine.
2. Laboratory examination of various body fluids for screening and diagnosis of diseases.
3. To study the tests required for assessing various organ functions.
4. Laboratory examination of formed elements of blood and to study different tests involved in the diagnosis of disorders of blood.
5. To study blood group systems, blood transfusion, screening tests for infections transmissible by transfusion and its adverse effects.

Course outcomes:

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

1. Explain the significance of clinical pathology in screening and diagnosis of diseases.
2. Describe the role of laboratory in examination of various body fluids, metabolic disorders, gastric anatomy, pregnancy and reproductive system disorders.
3. Explain the structure and function of different organs present in clinical pathology setting and enlist the classification of tests required for evaluating those respective organ functions.
4. Enlist the components of blood and describe the role of several formed elements of blood in clinical pathology.
5. Describe the blood group systems, types of blood donors, screening and identification of antibody.

COURSE CONTENT

GENRAL CLINICAL PATHOLOGY		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Laboratory tests for organ function and examination of body fluids:

Basic principles of laboratory medicine, Examination of Urine, Kidney Function Tests, Laboratory test in Diabetes Mellitus, Liver Function test, Laboratory test in disorders of lipids, Biochemical Cardiac Markers, Examination of Cerebrospinal fluid, Examination of Synovial Fluid, Examination of Sputum.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Gastric system and reproductive system analysis:

Examination of Feces, Gastric Analysis, est for Malabsorption and Pancreatic function test, Thyroid

function test, Laboratory tests in pregnancy, Infertility, Semen Analysis, Pyrexia of unknown origin.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Methods for estimation of Blood cell count:		
Haematopoiesis, Collection of blood, Automated complete blood cell count, Estimation of Haemoglobin, Packed cell volume, Total leucocyte count, Reticulocyte count, Platelet count, Blood smear, Red cell indices, Erythrocyte sedimentation rate, Examination of bone marrow.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Laboratory test for disorders of Blood:		
Malignancy, Laboratory test in bleeding disorders, Laboratory test in Thrombophilia, Laboratory Hematology of infectious disease, Laboratory tests in anaemia, Laboratory test in Hematological test in porphyrias.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Blood group systems and Transfusion of blood:		
Blood Group systems, Blood grouping, Collection of donor blood, processing and storage, Screening tests for infections transmissible by transfusion, Antibody Screening and Identification, Compatibility Test, Whole blood, blood components and blood derivatives, Adverse effects of Transfusion.		
Text Books:		
1. "Essentials of Clinical Pathology" by Shirish M. Kawthalkar, JP Medical Ltd, 2018.		
Reference Books: 1. Clinical Pathology, Hematology & Blood banking, 3rd Edition, Nanda Maheshwari. 2. Clinical Pathology Interpretations, A.H.Nagi, Fourth Edition. 3. Essential textbook of Clinical Pathology with Practicals, Tapeshwar yadav & Asheshwar Yadav. 4. Consise text in Clinical pathology, Hematology & Blood banking, Surabhi Bansal, AITBS Publisher. 5. Laboratory Manual of clinical pathology and hematology, Santosh Kumar Mondal. 6. A consise textbook of Clinical Pathology, Hematology & Blood banking, Rakesh Joshi.		

HERBAL HOME REMEDIES (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**HERBAL HOME REMEDIES**	**Short Title:**	HHR	**Course Code:**	**OE – 307 F**

The herbal home remedies course is designed to introduce individuals to the power of natural, plant-based remedies that can be used for common ailments and overall health maintenance. Participants will learn the principles of herbal medicine, understand the therapeutic properties of different herbs, and explore how to incorporate them into daily life through simple, safe, and effective home remedies. The course will cover a wide range of herbs and their uses in treating various conditions, including digestive issues, skin problems, stress, sleep disturbances, and immune system support. By the end of the course, students will have the knowledge to prepare herbal teas, tinctures, salves, and other remedies.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Understand the basics of herbal medicine and its history in various cultures.
2. Familiarize yourself with common medicinal herbs and their healing properties.
3. Gain hands-on experience in making teas, tinctures, syrups, salves, and poultices.
4. Discover herbal solutions for everyday health concerns like colds, headaches, digestive problems, and skin issues.
5. Learn how to incorporate herbs into your diet, beauty routines, and wellness practices.

Course outcomes:

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

1. Identify and classify common herbs and their medicinal uses.
2. Create their own herbal remedies such as teas, tinctures, and oils tailored to specific health needs.
3. Apply natural remedies to improve personal health and wellness in a safe and sustainable way.
4. Understand how to work with herbs to support emotional and physical balance in the body.
5. Integrate herbs into daily routines to enhance lifestyle, nutrition, and overall well-being.

COURSE CONTENT

HERBAL HOME REMEDIES		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Herbal Medicine:

Definition of herb, herbal medicine, Source of Herbs, Basic introduction of Ayurveda, Siddha, Unani and Homeopathy, Introduction of in cultivation of medicinal plants, Leaf, bark, root, seed, flowers, fruits & gums.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Herbal Identification and Properties:

Basic home remedies for general problem: Cold and Cough, Fever, Acidity, Itching, Constipation, Headache, Toothache, Vomiting.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Preparing Herbal Remedies:		
Source of minerals, vitamins, protein, Source of home spices & plant: honey, ashwagandha tulsi, shilagit, bhel, adulsa, pipal, black pepper , caraway seeds , cardamom seed powder , cayenne , celery seed , chives , chile peppers , Korintje cinnamon , Vietnamese cinnamon , cloves , cumin , dill seed , dill weed , garlic , gumbo filé , lemon , mace , marjoram , nutmeg , onion , oregano (Mediterranean).		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Herbal Remedies for Common Ailments:		
Herbal compound for oral care, skin care, sun care, hair care, decorative cosmetics, body care and perfumes.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Integrating Herbal Remedies into Daily Life:		
Preparation of Ayurvedic formulations viz powder, Ghutika, Churna and Bhasma.		
Text Books:		
1. "Textbook of Pharmacognosy" by Trease & Evans. 2. "Pharmacognosy" by Kokate, Purohit and Gokhale.		
Reference Books: 1. Pharmacognosy & Phytochemistry by V. D. Rangari. 2. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).		

PSYCHOLOGY OF WELL-BEING (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**PSYCHOLOGY OF WELL-BEING**	**Short Title:**	POWB	**Course Code:**	**OE – 307 G**

The Psychology of Well-Being course explores the psychological factors that contribute to human flourishing, happiness, and life satisfaction. This course delves into the scientific study of well-being, examining how positive emotions, healthy relationships, resilience, and personal growth influence mental and physical health. Students will explore theories and research from positive psychology, focusing on practical strategies to enhance personal well-being and cultivate a meaningful life. By understanding the psychological principles behind well-being, students will be better equipped to foster positive mental health both in themselves and in others.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

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Course objectives:

The objective of this course is to:

1. The psychological and physiological benefits associated with experiencing positive emotions, such as improved resilience, mental health, and social connections.
2. The mindfulness and its components, including present-moment awareness, non- judgmental acceptance, and compassion.
3. The different strategies for developing and enhancing emotional intelligence skills, including mindfulness practices, self-reflection exercises, and social skill-building activities.
4. The important concepts of well-being like conflict resolution, reconciliation, and stress management
5. Include mindfulness practices, self-reflection exercises, and social skill-building activities.

Course outcomes:

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

1. Understand the positive emotion and well-being, including the ability to define and differentiate these concepts from other affective states and mental health constructs.
2. Demonstrate an understanding of mindfulness principles and techniques, including the ability to define mindfulness and its components such as present-moment awareness, non-judgmental acceptance, and compassion.
3. Develop strategies for enhancing emotional intelligence competencies, including mindfulness practices, self-reflection exercises, and social skill-building activities.
4. Collaborate with peers to explore the application of gratitude and forgiveness principles in real-world scenarios, such as conflict resolution, reconciliation, and stress management, demonstrating the ability to work effectively with others and apply learned concepts in practical settings.
5. Developing personal tools and strategies for enhancing individual well-being.

COURSE CONTENT

PSYCHOLOGY OF WELL-BEING		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE)	**40 marks**

		CA:	
Unit–I:	**No. of Lectures: 09 Hours**		**Marks: 12**
Positive emotion and well-being : Positive Emotions: Meaning of Positive Emotions, Identifying Positive Emotions, Benefits of Positive Emotions Barbara Fredrickson's Broaden and Build Theory of Positive Emotions Positive Emotions and Health Resources: Physical, Psychological and Social Resources. Positive Emotions and Well-being: Happiness and Positive Behaviour, Positive Emotion and Success, Positive Emotion and Flourishing (PERMA Model)Cultivating Positive Emotions: Flow Experiences, savoring.			
Unit–II:	**No. of Lectures: 09 Hours**		**Marks: 12**
Mindfulness and well-being :			
Mindfulness: Meaning, Mindfulness as an Antidote for Mindlessness, Mindfulness as Present-centered, Awareness and Attention Mindfulness Meditation ,Attributes of Mindful Awareness- Non-Judging, Patience, Beginner Mind, Trust, Non-Striving, Acceptance, Letting go. Benefits of Mindfulness, Mindfulness and Mental Health, Living with Mindfulness: Being Mindfulness of Emotion, Being Mindfulness of Eating, Being Mindfulness of Exercise, Mindfulness Breathing and sitting as a Meditation Mindfulness and Happiness.			
Unit–III:	**No. of Lectures: 09 Hours**		**Marks: 12**
Emotional intelligence:			
Emotional Intelligence, Meaning, Nature and Definition Theories of EI, Peter Salovey and John D Mayre, Danial Golman, Bar-On Emotional Intelligence and Happiness Ways That Emotionally Intelligent People Choose for Happiness Factors - Emotional Intelligence Be Increased, Manage another Person's Emotions.			
Unit–IV:	**No. of Lectures: 09 Hours**		**Marks: 12**
Gratitude and forgiveness :			
Gratitude: Meaning and Concept, Characteristics of Gratitude People, Gratitude Physical and Mental Health, Gratitude and Happiness ,Ways to Practice Gratitude Forgiveness Meaning, Definition, Importance and Types ,Benefits of Forgiveness, Forgiveness is the key of Happiness.			
Unit–V:	**No. of Lectures: 09 Hours**		**Marks: 12**
Happiness and the Facts of Life :			
Happiness Across the Life-Span - Focus on Research: Happiness and Where we Live - Stability in Well-Being Despite Life Changes - Temperament and Subjective Well-Being - Frequency, Intensity and Balance of Positive and - Negative Emotions - Measurement and Definitional Issues -The Shifting Basis of Life Satisfaction - Gender and Happiness - Gender differences in Emotional Experience - Negative Emotions - Positive Moods and Behaviors - Explaining the Paradox of Gender Other Facts of Life - Physical and Mental Health ,Work and Unemployment , Intelligence and Education - Religion - Race, Ethnicity and Stigma.			
Text Books:			
1. "The Role of Positive Emotions in Positive Psychology: The Broadenand-Build Theory of Positive Emotions" by Fredrickson, B. L. (2001) American Psychologist, 56, 218-226.			
Reference Books:			
1. Steve B. & Marie, C. (2015). Positive Psychology. Pearson Education. 2. Snyder C.R., Lopez S.J., Pedrotti J.T. (2011) Positive Psychology. Sage Publication.			
NPTEL Links: 1. Introduction to Psychology By Prof. Braj Bhushan, IIT Kanpur https://onlinecourses.nptel.ac.in/noc21_hs49/preview			

FUNDAMENTALS OF BANKING (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**FUNDAMENTALS OF BANKING**	**Short Title:**	FOB	**Course Code:**	**OE – 307 H**
This course provides a fundamental understanding of banking concepts, types of banks, negotiable instruments, banking operations, and remittance methods. It covers essential topics like account management, banking regulations, and digital banking services, equipping students with foundational knowledge for careers in banking and finance.					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Explain the basic concepts, evolution, and significance of banking.
2. Provide knowledge of different types of bank accounts and their operations.
3. Introduce negotiable instruments and their role in banking transactions.
4. Familiarize students with endorsements, remittances, and digital banking methods.
5. Develop an understanding of banking regulations, customer protection, and ethical banking practices.

Course outcomes:

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

1. Understand the fundamental concepts and functions of banking.
2. Identify different types of bank accounts, cooperative banking structures, and their significance.
3. Analyze the characteristics and legal aspects of negotiable instruments and endorsements.
4. Evaluate different means of remittances and their role in modern banking.
5. Apply knowledge of banking regulations, digital banking, and financial security measures.

COURSE CONTENT

FUNDAMENTALS OF BANKING		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Banking

Meaning and definition of banking
Evolution of banking in the world and in India
Importance of banking in the Indian economy
Types of banks – Commercial Banks, Cooperative Banks, Development Banks, and Central Bank

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Banking Operations and Account Management

Types of bank accounts – Savings, Current, Fixed Deposit, Recurring Deposit, Non-Resident Accounts
Procedure for opening, operating, and closing accounts

KYC norms and customer due diligence Role of banks in financial inclusion		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Negotiable Instruments and Endorsements		
Meaning, characteristics, and types of negotiable instruments – Promissory Notes, Bills of Exchange, Cheques Types of cheques – Bearer, Order, Crossed (General & Special) Endorsements – Definition, characteristics, types (Blank, Special, Partial, Restrictive, Conditional, Facultative) Rights and liabilities of parties to negotiable instruments		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Remittance Services and Digital Banking		
Different means of remittances – Demand Drafts, Letters of Credit Credit Cards, Debit Cards, ATMs – Advantages and Disadvantages MICR cheques and their significance Introduction to digital banking – NEFT, RTGS, UPI, Mobile Banking		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Banking Regulations and Ethical Practices		
Role of regulatory authorities – RBI, SEBI, and their functions in banking Consumer protection in banking – Banking Ombudsman Scheme Common banking frauds and security measures Ethical banking practices and financial literacy		
Text Books:		
1. "Basics of Banking and Finance" by K.M. Bhattacharya & O.P. Agrawal, Himalaya Publishing House. 2. "Fundamentals of Banking Theory and Practice" by A.K. Basu.		
Reference Books: 1. Elements Banking and Insurance – B. S. Shah Publication, Ahmadabad 2. Elements of Banking and Insurance – New Popular Publication, Surat 3. Banking Theory and Practice, Prem Kumar Srivastava, Himalaya Publishing House.		
NPTEL Links: 1. Management of Commercial Banking by Prof. Jitendra Mahakud, IIT Kharagpur https://nptel.ac.in/courses/110105143		

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Second Year Bachelor of Engineering

in

Electrical

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE

For Affiliated Colleges

Semester –IV

W.E.F. 2025 – 26

ELECTRICAL MACHINES-II (PCC)

COURSE OUT LINE

Course Title:	ELECTRICAL MACHINES-II	Short Title: EMC-II	Course Code:	EE401

Course description:

This course is an advanced level Electrical Machines-I which will further strengthen the knowledge of the students. The course explores on understanding of construction, basic principles underlying the operation of electrical machines, performance, characteristic and testing of AC Machines, Voltage regulation of synchronous alternator, parallel operation and salient features and characteristic of synchronous motor. It also gives the platform to understand construction, working, performance and application of three phase and single phase motors.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand fundamental knowledge of Synchronous machines and induction motors.
2. Develop their ability to apply the specific procedures for comprehensive treatment of rotating machines.
3. Demonstrate the characteristic of three phase synchronous machine on infinite bus and in parallel operation.
4. Conduct test on synchronous motor and induction motor for evaluate performance characteristics.
5. Perform professional duties in the field of manufacturing, testing operation and control of machine.

Course outcomes:

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

1. Understand fundamental principles of operation and construction for three phase synchronous machines and induction motor.
2. Solve engineering problems three synchronous alternator, motor and induction motor.
3. Identify type of three phase synchronous and induction motor.
4. Analyze test data for qualitative and quantitative parameters to determine characteristics of three phase synchronous alternator, motor , induction motor and single phase motor.
5. Evaluate the steady state parameters, basic operating characteristics and performance of three phase synchronous alternator, motor ,induction motor and single phase motor.

COURSE CONTENT

ELECTRICAL MACHINES-II		Semester:	IV
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40 marks**

Unit–I	No. of Lectures: 09 Hours	Marks: 12

Three Phase Synchronous Alternator-I: Construction and working operation of three phase alternator, rotor construction type ,excitation system, rotating magnetic field system, armature winding, winding factor, emf equation, alternator on load, armature reaction, synchronous impedance, Voltage regulation of cylindrical rotor synchronous alternator by direct load testing, synchronous impedance method and m.m.f. method.

Unit–II	No. of Lectures: 09 Hours	Marks: 12
Three Phase Synchronous Alternator-II: Two reaction theory for salient pole synchronous machines, direct axis and quadrature axis reactance, power angle characteristic of synchronous alternator, Parallel operation of alternator: need, conditions and method of parallel operation, , Effect of change of mechanical torque and excitation for parallel operating alternators. Load sharing between two parallel connected alternators. Synchronous alternator on an infinite bus .		
Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**
Induction Motor-I: Construction, working operation of three phase induction motor, type of three phase induction motor ,development of torque, torque slip characteristic, maximum torque condition, High torque cage induction motor, Double cage squirrel induction motor power flow, losses and efficiency, equivalent circuit, No load and Block rotor test, Construction of circle diagram and calculation.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Induction Motor-II: Starting of three phase induction motor, Starter type and application, speed control of induction motor, Cogging and magnetic locking. Effect of change of supply voltage and frequency, effect of harmonic (Crowing) Single Phase Motor: Classification of single-phase induction motor, construction and working operation, torque speed characteristic and application of slip phase, shaded pole and capacitor start induction motor, AC series motor.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Three Phase Synchronous motor: Working operation, main features of synchronous motor, torque of synchronous motor, equivalent circuit, Power flow, Effect of change of excitation at constant load, effect of change of load at constant excitation, Starting and hunting of synchronous motor, synchronous motor application.		

Text Books:

1. Ashfaq Husain, “Electrical Machines”, Dhanpat Rai & Co.
2. B. L. Tharaja, “Course in Electrical Technology, Volume-II,” S Chand Publication.
3. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.

Reference Books:

1. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
2. P. S. Bimbhra, “Generalized Electrical Machines”, Khanna Publishers, 2011.
3. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
4. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
5. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.

NPTEL Links:

1. Armature winding of synchronous alternator by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105131/
2. Parallel operation of alternator by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105131/
3. Induction motor operation and torque by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105131/
4. Induction and Synchronous Motors by G Sridhara Rao, IITM
   https://archive.nptel.ac.in/courses/108/106/108106072/
5. Synchronous motor by Prof. G.Bhuvaneshwari, IITD
   https://archive.nptel.ac.in/courses/108/102/108102146/
6. Single phase induction motor by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105131/

ELECTRICAL MACHINES-II LAB (PCC)					
LAB COURSE CONTENT					
ELECTRICAL MACHINES-II LAB		**Semester:**	**IV**	**Course Code:**	**EE402**
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: PR**			**25 marks**
		Internal Continuous Assessment (ICA) CA:			**25 marks**
End Semester Exam (ESE) Pattern:		**(Practical) PR**			

Concerned faculty member should suitably frame **SEVEN** laboratory assignments from the following list.

1. Determination of voltage regulation of three phase alternator by direct load test.
2. Open and short circuit test on three phase alternator: determination of its regulation by e.m.f. method and m.m.f. method.
3. Zero power factor test on three phase alternator: determination of regulation by Potier triangle method.
4. Determination of direct axis and quadrature axis reactance by slip test on synchronous machine. Determination of voltage regulation by two reactance theory.
5. Synchronizing alternators: lamp methods and use of synchroscope.
6. Synchronous alternator on infinite bus: behavior of machine under change in mechanical power and excitation.
7. Determination of performance of three phase induction motor by direct load test.
8. Determination of performance of three phase induction motor by no load, blocked rotor test and construction of circle diagram.
9. No load and blocked rotor tests on capacitor start single phase induction motor and determination of parameters of equivalent circuit.
10. Load test on single phase induction motor.
11. Speed control of three phase slip ring induction motor.
12. Characteristic of synchronous motor at constant load and variable excitation.
13. Characteristic of synchronous motor at constant excitation and variable load.

Text Books

1. S.G Tarnekar ,P K Kharbanda, “A Text Book on Laboratory Course in Electrical Engineering,” S Chand Publication.
2. B. L. Tharaja, “Course in Electrical Technology, Volume-II,” S Chand Publication.

Reference Books:

1. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
2. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013. .

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guide lines for ESE:

ESE will be based on the laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

ANALOG AND DIGITAL ELECTRONICS (PCC)

COURSE OUT LINE

Course Title:	ANALOG AND DIGITAL ELECTRONICS	Short Title: ADE	Course	EE403

Course description:

This course provides an introduction to solid state devices, power semiconductor devices, linear integrated circuits and voltage regulator ICs which includes over view of semiconductor devices, integratedcircuits,theircharacteristicsandapplications,digitalelectronics,combinational circuits, sequential circuits.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand to BJT and rectifier.
2. Develop the concept of basics of operational amplifier, timers and its applications.
3. Understand the behavior of semiconductor devices operated as power switches.
4. Understand digital electronics SOP and POS form, k-map technique, flip-flops, sequential circuits such as ripple counter,
5. Understand synchronous counter, Mod-n counter, shift resister and its applications.

Course outcomes:

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

1. Apply basic knowledge of science and engineering to understand electronic devices and circuits such as rectifier, amplifiers etc.
2. Analyze the circuit for determination of circuit parameters and response of op-amp IC741 and its applications.
3. Describe the use of different integrated circuits timers, PLL and voltage regulators.
4. Illustrate the basic logic gates and various reduction techniques of digital logic circuit in detail and gain the basic concept of combinational circuits.
5. Design sequential circuits using excitation and state table.

ANALOG AND DIGITAL ELECTRONICS

ANALOG AND DIGITAL ELECTRONICS		Semester:	IV
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40 marks**

Unit–I	No. of Lectures: 09 Hours	Marks: 12

BJT and Applications: Transistor characteristics: The junction transistor, transistor as an amplifier, CB, CE, CC configurations, comparison of transistor configurations, the operating point, self-bias or Emitter bias, bias compensation, thermal runaway and stability, transistor at low frequencies, CE amplifier response, gain bandwidth product, Emitter follower, RC coupled amplifier, two cascaded CE and multistage CE amplifiers.

Unit–II	No. of Lectures: 09 Hours	Marks: 12

Operational amplifier: Op-amp parameters such as CMRR, slew rate, frequency response and gain limitations. Inverting, non inverting amplifier. Summer and subtractor. Op-amp applications:Integrator,differentiator.Op-ampasComparator,Schmitttrigger,Instrumentation

amplifier, Waveform generation using Op-amp–sine, square and triangular.

Unit–III	No. of Lectures: 09 Hours	Marks: 12

Timer and Voltage Regulators: IC 555 Timer: Functional block diagram, modes of operation-Astable, Monostable, Types of voltage regulators, Series and shunt voltage regulators, Protection circuits for voltage regulators, Fixed and variable voltage RegulatorsusingICsViz78xx,79xx, LM723,LM317. Study of VCO and PLL

Unit–IV	No. of Lectures: 09 Hours	Marks: 12

Combinational Circuits: Standard representation of logic functions: SOP and POS forms, K-map (for 2, 3 & 4 variables): representation of logic functions, simplification of logic functions and minimization of logic functions, don't care conditions. Arithmetic and logical functions: adders and subtractor (Half and Full), BCD-to-7-segment decoder, Code converters: binary-to-gray and gray-to-binary,D ata transmission: Encoders, Multiplexers, Demultiplexers, look ahead carry.

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Flip-Flops and Sequential Circuits:

A 1-Bit Memory Cell, Clocked S-R flip-flop, Edged triggered J-K flip-flop, Race around condition, J-K master slave flip-flop, Edged triggered D- type flip-flop, T-type flip-flop. Classification of sequential circuits-synchronous and as synchronous, Registers, application of shift registers, ringcounter, twistedring counter. Asynchronous and synchronouscounter,4bit UP/DOWN ripple counter.

Text Books:

1. S. Salivahanan, N. Suresh Kumar, "Electronic devices and circuit", McGraw hill education (India) private limited, Chennai, 4th edition, 2017.
2. Ramakant A. Gaikwad, "Op-Ampand Linear Integrated Circuits",PHI Learning Pvt. Ltd, Delhi, 2014.
3. R.P.Jain, "Modern Digital Electronics" McGrawHill Education (India)Private Limited, Fourth Edition, 2017.

Reference Books:

1. DavidA.Bell,"Electronicsdevicesandcircuit",OxfordUniversityPress,5th edition,2015.
2. K.R.Botkar, "Integrated Circuit", Khanna Publication, New Delhi
3. RobertF.Coughlin,FrederickF.Driscoll,"OperationalAmplifierandLinearIntegrated Circuits", Pearson Education Asia, 6th Edition, 2001.
4. Stephen Broown, ZvonkoVranesic, "Fundamental of Digital Logic with VHDL Design", McGraw Hill Publication, 3rd edition, 6threprint, 2015.
5. David J. Comer, "Digital Logic and State Machine Design", Oxford University Press, 3rdedition, 2014.
6. L.K.Maheshwari, "Analog Electronics", Laxmi Publications.

NPTEL Links:

1.Analog Electronic circuit by Prof. Pradip Mandalp, IIT Kharagpur
https://archive.nptel.ac.in/courses/108/105/108105158/
2. Opamp circuits by Prof.Shouribrata Chatterjee, IIT Delhi.
https://archive.nptel.ac.in/courses/108/102/108102112/
3. Digital Electronic circuit by Prof. Goutam Saha, IIT Kharagpur
https://archive.nptel.ac.in/courses/108/105/108105132/

ANALOG AND DIGITAL ELECTRONICS LAB (PCC)					
LAB COURSE CONTENT					
ANALOG AND DIGITAL ELECTRONICS LAB		**Semester:**	**IV**	**Course Code:**	**EE 404**
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: PR**			**25 marks**
		Internal Continuous Assessment (ICA) CA:			**25 marks**
End Semester Exam (ESE) Pattern:		**(Practical) PR**			

Concerned faculty member should suitably frame **SEVEN** laboratory assignments from the following list.

1. Observe the input and output voltage of half wave, full wave rectifiers.
2. Op-amp as square wave ,sine wave generator using IC741.
3. Op-amp as Inverting and non-Inverting summer using IC741
4. Op-amp as Schmitt trigger using IC741.
5. IC555 applications – Astable & Monostable Multivibrator.
6. Low voltage regulator using IC723.
7. High voltage regulator using IC723.
8. IC78XXused as Positive voltage regulator.
9. IC79XX used as Negative voltage regulator.
10. Design and verify operation of half adder and full adder.
11. Design and verify operation of half substractor.
12. Design and construct basic flip-flops.
13. Design and verify the 4-bit synchronous counter.
14. Design and verify the 4-bit asynchronous counter.

Text Books:

1. Ramakant A. Gaikwad, “Op-Ampand Linear Integrated Circuits”,PHI Learning Pvt. Ltd, Delhi, 2014.
2. R.P.Jain, “Modern Digital Electronics” McGrawHill Education (India)Private Limited, Fourth Edition, 2017.

Reference Books:

1. DavidA.Bell,“Electronicsdevicesandcircuit”,OxfordUniversityPress,5th edition,2015.
2. K.R.Botkar, “Integrated Circuit”, Khanna Publication, New Delhi
3. RobertF.Coughlin,FrederickF.Driscoll,“OperationalAmplifierandLinearIntegrated Circuits”, Pearson Education Asia, 6th Edition, 2001.
4. Stephen Broown, ZvonkoVranesic, “Fundamental of Digital Logic with VHDL Design”, McGraw Hill Publication, 3rd edition, 6threprint, 2015.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guide lines for ESE:

ESE will be based on the laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

ELECTRICAL MEASUREMENT LAB (PCC)					
COURSE OUTLINE					
Course Title:	**ELECTRICAL MEASUREMENT LAB**	**Short Title:**	**EML**	**Course Code:**	**EE405**

Course description : In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic, performance of different measuring instruments and measurement of different electrical quantities. It also gives the platform to understand need and importance of calibration and standardization.

	Hours/week	**No. of**	**Total hours**	**Semester credits**
Theory	1	15	15	**02**
Practical	2	15	30	

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand the fundamental knowledge of measuring instruments.
2. Understand the working operation of different measuring instruments
3. Ability to select the specific instrument in reference of ranges and resolution of instruments for proper and correct analysis.
4. Understand the characteristic of measuring instruments.
5. Calibrate the measuring instrument and understand the class of accuracy.

Course outcomes:

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

1. Learn construction and operating principles of electrical instruments.
2. Measure various electrical quantities and circuit parameters.
3. Identify measuring instrument with proper range and class of accuracy for different application.
4. Calibrate various types of instruments as per IS.
5. Compare the digital measuring equipment for measurement of various electrical parameters.

COURSE CONTENT

ELECTRICAL MEASUREMENT LAB		**Semester:**	**IV**
Teaching Scheme:			
Lectures:	**1 hour/week**	**End Semester Exam (ESE) UA: PR**	**25 marks**
Practical:	**2 hour/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**
End Semester Exam (ESE) Pattern:		**(Practical) PR**	

Unit–I	**No. of Lectures: 03**	

Introduction to Measurement and instrumentation: Types and Classification of measuring instruments, Generalized measurement system, standards, and calibrations, types of Errors — ,Extension of ranges, Instrument transformers

Unit–II	**No. of Lectures: 03**	

Measurement of Current and Voltage: Classification of Voltmeter and Ammeters, type of construction, Advantages and limitation, Class of accuracy, Extension of ranges, Instrument transformers, Digital voltmeter and ammeter.

Unit–III	No. of Lectures: 03	

Measurement of Power: Construction and principle of operation of electrodynamic wattmeter, low P. F. wattmeters, Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter metho

Unit–IV	No. of Lectures: 03	

Measurement of Energy: Construction and principle of operation, Torque equation for the induction type of energy-meter, Calibration of Energy meters, and three phase energy meter. Electronic Energy meters- construction and principle

Unit–V	No. of Lectures: 03 Hours	

Introduction to transducers: Transducers: Definition, classification, selection of transducer. Measurement of temperature: Using R T D, thermocouple. Pressure Measurement: Bourdon Tubes, bellows, diaphragms. Displacement measurement: LVDT, strain gauge -types, working principles

LAB COURSE CONTENT

Concerned faculty member should suitably frame **SEVEN** laboratory assignments from the following list.

1. Measurement of active power and reactive power in three phase circuit by two wattmeter method.
2. Measurement of power factor in inductive and capacitive load by power factor meter.
3. Calibration of single phase energy meter at different P.F
4. Calibration of three phase two elements energy meter at different P.F.
5. Measurement of Voltage, Current, Power, Power factor by multifunction digital meter.
6. Strain Measurement using strain gauge.
7. Measurement of temperature by RTD/Thermocouple.
8. Measurement of pressure by using pressure transducer.
9. Measurement of displacement by using LVDT.
10. Measurements of phase angle error and ratio error of current Transformer
11. Measurements of phase angle error and ratio error of Potential Transformer

Text Books:

1. A. K. Sawney. “Electrical & Electronic Measurement and Instrumentation” Danpant Rai & Co.
2. E. W. Golding, “Electrical Measurements and Measuring instruments”, Reem Publication, 23rd edition.

Reference Books:

1. C. T. Baldwin, “Fundamentals of Electrical Measurements”, Kalyani Publication, 2 nd edition.
2. Cooper and Derfllick, “Electronic Instrumentation and Measurements Techniques”, Prentice-Hall of India, 3 rd edition.
3. J. B. Gupta, “Electrical & Electronic Measurement and Instrumentation”, S. K. Kataria & Son, 14th edition.
4. R. K. Rajput, “Electrical & Electronic Measurement and Instrumentation”, S. Chand.

NPTEL Links:

1. Classification of instrument , working byProf. Avishek Chatterjee, IIT Kharagpur
   https://archive.nptel.ac.in/courses/108/105/108105153/
2. Introduction to instrument by Prof. Avishek Chatterjee, IIT Kharagpur
   https://archive.nptel.ac.in/courses/108/105/108105153/
3. Industrial Instrument by Prof. Alok Barua, , IIT Kharagpur
   https://archive.nptel.ac.in/courses/108/105/108105064/

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark of each assignment on completion date declared for each assignment.

Guide lines for ESE:

ESE will be based on the laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

ELECTROMAGNETIC FIELDS (MD M)					
COURSE OUTLINE					
Course Title:	**ELECTROMAGNETIC FIELDS**	**Short Title:**	EMF	**Course Code:**	**EE406**

Course description:
This course examines electric and magnetic quasi static forms of Maxwell's equations applied to dielectric, conduction, and magnetization boundary value problems.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	**02**

Prerequisite course(s):
Engineering Mathematics, Introduction to Electrical and Electronics Engineering, Vectors, Vector Calculus.

Course objectives:
The objectives of the course are to learn
1. Determine and describe static and dynamic electric and magnetic fields for technologically important structures: the coil,
2. Describe charge distributions, the dipole, the coaxial cable, dielectric and conducting spheres.
3. Understand the coupling between electric and magnetic fields through Maxwell's equations.
4. Knowledge of, physical interpretation, and ability to apply Maxwell's equations
5. Determine field waves, potential waves, and energy and charge conservation conditions.

Course outcomes:
After successful completion of this course the student will be able to:
1. Apply the basic concept of mathematics and laws of electromagnetism.
2. Explain the electric and magnetic fields for simple configurations under static conditions.
3. Analyze the different conditions of conductors, dielectrics and capacitance.
4. Analyze static magnetic fields.
5. Analyze time varying electric and magnetic fields and apply Maxwell's equation in different form to understand.

COURSE CONTENT

ELECTROMAGNETIC FIELDS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**
		Internal Continuous Assessment (ICA) CA:	**25 marks**

Unit–I	**No. of Lectures: 06 Hours**	**Marks: 12**

Vector Calculus: Vector algebra- Components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Unit–II	**No. of Lectures: 06 Hours**	**Marks: 12**

Static Electric Field: Coulomb's law, Electric field intensity due to different charge distribution, Electric flux density, Gauss' law, Divergence and Divergence theorem, Maxwell's first equation Potential and potential difference, Potential field of system of charges, Potential gradient, energy density in electric field. Poisson and Laplace Equation.

Unit–III	No. of Lectures: 06 Hours	Marks: 12

Static Electric Field in Dielectrics: Continuity of current, Conductor properties and boundary conditions Nature of dielectrics, Boundary conditions for perfect dielectric material polarization and its effect in dielectric.

Unit–IV	No. of Lectures: 06 Hours	Marks: 12

Steady Magnetic Field: Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Magnetic field and magnetization, Boundary conditions in magnetic field. Force on a moving charge, Force on a differential current element, Force between differential current elements. Magnetization and permeability, Magnetic circuits, inductances and mutual inductances.

Unit–V	No. of Lectures: 06 Hours	Marks: 12

Time Varying Field & Uniform Plane Wave :

Time Varying Field: Faraday's law, displacement current, Maxwell's Equations in point form and integral form. Motional Electromotive forces. Boundary Conditions.

Uniform Plane Wave : Wave propagation in free space, in dielectrics, Pointing vector and power consideration, Wave propagation in good conductor: Skin effect Reflection of uniform plane waves at normal incidence.

Text Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. R. K. Shevgaonkar, "Electromagnetic Waves", McGraw Hill

Reference Books:

1. Brij Lal, M.N. Avadhanulu, and N.Subrahmanyam, "A Textbook of Optics" -,S Chand Publishing
2. MK Verma , "Introduction to Mechanics" — CRC Press
3. S. O. Pillai, M. A. Wahab, A.J. Dekker, Charles Kittel, "Solid State Physics" –Narosa Publishing
4. David Griffiths, "Introduction to Electromagnetic Theory" - Pearson Education Publishing
5. Richard Robinett, "Quantum mechanics" - Oxford University Press.
6. Arthur Beizer, "Concept of Modern Physics" –McGraw Hill Publishing
7. William H. Hayt, Jr& John A. Buck, "Engineering Electromagnetic", 7th edition, Tata McGraw:Hill

NPTEL Links:

1. Electromagnetic Theory by Prof. Pradeep Kumar K, https://archive.nptel.ac.in/courses/108/104/108104087/
2. Introduction to Electromagnetic Theory by Prof. Manoj Harbola, https://archive.nptel.ac.in/courses/115/104/115104088/
3. Electromagnetic Theory by Prof. D K Ghosh, https://archive.nptel.ac.in/courses/115/101/115101005/

Guidelines for ICA:

Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.

MAINTENANCE OF ELECTRICAL INSTALLATION (VSEC)					
COURSE OUTLINE					
Course Title:	**MAINTENANCE OF ELECTRICAL INSTALLATION**	**Short Title:**	**MEI**	**Course Code:**	**EE 408**

Course description: The majority of Electrical Engineering are absorbed by the industry & state electricity boards where they are expected to do routine, preventive & breakdown maintenance of electrical equipment, to inspect & assist in testing the manufacturer & commissioned equipment as per ISS & to install machine as per manufactured instructions. The course explore the knowledge of repair and maintenance of electrical installation.

	Hours/week	**No. of**	**Total hours**	**Semester credits**
Practical	2	15	30	1

Prerequisite course(s):

Basic Electrical and Electronic Engineering at FE and Electrical Machines-I at SE

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand the various causes of failure of electrical machines.
2. Understand the various types of maintenance & prepare the schedule of maintenance.
3. Understand the conditions & procedure for parallel operation of transformers, alternators.
4. Implement the various methods/procedures prescribed as per IS code of Practice in testing of electrical machines.
5. Apply techniques/steps to rectify and repair the faults in electrical machines.

Course outcomes:

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

1. Prepare schedule of maintenance for electrical machines in an industry.
2. Carryout periodic maintenance (Routine/preventive/breakdown) of electrical machines.
3. Maintain history sheet/ log book for prediction of repeated faults.
4. Identify, locate and define the fault in an electrical machine.
5. Use proper tools and equipment with safety precaution for testing and maintenance of electrical machines.

MAINTENANCE OF ELECTRICAL INSTALLATION			
LAB COURSE CONTENT			
MAINTENANCE OF ELECTRICAL INSTALLATION		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Concerned faculty member should suitably frame **SEVEN** laboratory assignments from the following list.

1. Identification of fault in home appliances.
2. Identification of fault in cable.
3. Study of Motor Starters.
4. Electrical Tests before commissioning of Transformer : Measurement of winding resistance, voltage ration and Terminal marking of distribution transformer.
5. Electrical Tests before commissioning of Transformer : Measurement of insulation resistance and dielectric strength of transformer oil for distribution transformer.

6. Electrical Tests before commissioning of Transformer : Measurement of winding resistance of stator, armature, and field resistance of rotary electric machines.
7. Routine test on rotating machine : Measurement of No-load current, power and speed of motor.
8. Fault finding, trouble shooting of DC Machine, Induction Motor Prepare preventive maintenance schedule
9. Fault finding, trouble shooting of Transformer and prepare preventive maintenance schedule.
10. Fault finding, trouble shooting of DG Set and prepare preventive maintenance schedule.
11. Fault finding, trouble shooting of Solar PV Plant and prepare preventive maintenance schedule.
12. Maintenance schedule of LT and HT Circuit Breaker.
13. Electrical safety precautions and safety rule.

Text Books

1. S. Rao, "Preventive Maintenance of electrical machines &equipments Vol-I and Vol - II", M. P. Publication
2. S.G Tarnekar ,P K Kharbanda, "A Text Book on Laboratory Course in Electrical Engineering," S Chand Publication.

Reference Books:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
3. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
4. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
5. http://law.resource.org/pub/in/bis/ (For various IS code of practice)

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark of each assignment on completion date declared for each assignment.

ABILITY ENHANCEMENT COURSE (AEC)					
COURSE OUTLINE					
Course Title:	**ABILITY ENHANCEMENT COURSE**	**Short Title:**	**AEC**	**Course Code:**	**EE - 409**

Course description:

The Course Provides students English proficiency across four key skills: **Listening, Reading, Writing, and Speaking**. It is used for study, work, and migration purposes in English-speaking countries.

Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**15**	**30**	**01**

Course Objectives:

The objective of this course is:
1. Evaluate English proficiency for academic, professional, and migration purposes.
2. Provide an internationally recognized standard for English language assessment.
3. Develop language skills necessary for effective communication in diverse environments.
4. Prepare candidates for real-life language use in academic and work-related.
5. To equip students with **test-taking strategies** to maximize their scores.

Course Outcomes:

After successful completion of this course, the student will be able to:
1. Demonstrate a high level of English proficiency for academic, professional, or migration purposes.
2. Develop leadership and teamwork skills in collaborative environments.
3. Apply effective strategies for all Ability Enhancement modules.
4. Develop confidence in using English in real-life and test situations.
5. Achieve the required Ability Enhancement score for university admissions, work, or immigration.

COURSE CONTENT

ABILITY ENHANCEMENT COURSE		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 Marks**

Concerned faculty member should suitably frame **FOUR** assignments in the form of interactive Practice Sessions based on the following modules.

Listening:
1. **Activity 1:** Podcasts, news, speeches, conversations, storytelling, News websites, BBC CNN, NBC
2. **Practice 1:** Practice with audio materials (podcasts, TED Talks, movies)
3. **Practice 2:** Cornell Method, Mind Mapping, Key Points and Summarization
4. **Practice 3:** Listening tests and quizzes, Practical exercises

Reading:
1. **Activity 3:** Fiction, short stories, novels: News articles, essays, reports, Research papers, textbooks, Blogs, social media posts, online articles
2. **Practice 1:** Self-assessment and comprehension quizzes
3. **Practice 2:** Note-taking strategies for effective retention
4. **Practice 3:** Understanding idioms and figurative language
5. **Practice 4:** Context clues and word recognition

Writing:

1. **Activity 4:** Write a daily journal, Letters to an English speaker, Make lists of the things you see every day, Write descriptions of your family and friends.
2. **Practice 1:** Common writing mistakes and how to fix them.
3. **Practice 2:** Unity in writing (sticking to one main idea)
4. **Practice 3:** Poetry, short stories, scripts
5. **Practice 4:** Storytelling techniques, point of view, dialogue

Text Books:

1. Barron's, IELTS Practice Exam, New Age International Private Limited, 2nd Edition.

Reference Books:

1. IELTS 19 Academic, Authentic Practice Tests, Cambridge University Press,2024
2. Pauline Cullen, IELTS Academic and General Training, Cambridge University Press,2014

NPTEL Links:

1. Skills by Prof. Binod Mishra, IIT Roorkee, https://nptel.ac.in/courses/109107121
2. Skills Development by Prof. P. Patnaik, Prof. V.N. Giri, Prof. D. Suar, IIT Kharagpur, https://nptel.ac.in/courses/109105110

Links: (for online practice)

1. A noticeboard message | Learn English (britishcouncil.org)
2. Free IELTS on Computer familiarisation test (ieltsidpindia.com)

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on the completion date declared for each assignment.

ENTREPRENEURSHIP DEVELOPMENT(HSSM)					
COURSE OUTLINE					
Course Title:	**ENTREPRENEURSHIP DEVELOPMENT**	**Short Title:**	**ED**	**Course Code:**	**EE410**

Course description:

Last few decades have seen the advent of various new disciplines in the area of management. One such discipline, Entrepreneurship has emerged quite recently. The syllabus explore the concept of entrepreneurship, financial requirements of a new enterprise, Expansions strategies of an enterprise, challenges for small enterprises and Institutional Support for small enterprises

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	02

Prerequisite course(s):

Knowledge Management

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand economic objectives of country, such as industrial development, regional growth,
2. Understand the employment generation and development of small scale industries entirely depend on the growth of entrepreneurship.
3. Identify the challenges for entrepreneurs to select and implement business strategies to tread the glorious path of success and growth.
4. Discuss successful entrepreneurship requires passion of an entrepreneur and thus, it is more than the money and luck.
5. Understand the complexities of business environment at national and international levels.

Course outcomes:

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

1. Understandconceptofentrepreneurshipandlearntheprocedureofsettingupan enterprise.
2. Understand the concepts of human resource management, marketing management, financial management, production and operation management in a new enterprise.
3. Function on multidisciplinary teams and understand the impact of engineering solutions in a global, economic, environmental, and societal context.
4. Understand the role of small scale enterprises in economic development of a country and understand the linkage between small and large scale enterprises.
5. Develop skills to become entrepreneurs in view of economic objectives of country, such as industrial development, regional growth, employment generation and development of Small scale industries through technological developments.

COURSE CONTENT

ENTREPRENEURSHIP DEVELOPMENT	**Semester:**	**IV**
Teaching Scheme:		
Lectures: **2 hours/week**		

Unit–I	**No. of Lectures: 06 Hours**

Introduction to Entrepreneurship: Introduction, Concept of entrepreneurship: Significance of entrepreneurship, Theories of entrepreneurship, Models of entrepreneurship development
Definition of entrepreneur: Traits and characteristics of successful entrepreneur , Functions of an entrepreneur, Types of entrepreneurs, Factors influencing entrepreneur. Entrepreneurial process, Entrepreneurial motivation, Entrepreneurial barriers, Women as entrepreneur , Role of woman entrepreneurs in society, Barriers to women entrepreneurs.

Unit–II	No. of Lectures: 06 Hours	
Financial requirements of a new Enterprise: Estimating financial requirements, Estimation of fix capital requirements, Estimation of working capital requirements Identifying the sources of finance –sources of long-term financing: Sources of medium term financing, Sources of short-term financing Institutions providing financial assistance: Venture capital funding- venture capital funding in the Indian scenario, Venture capital funding process, Importance of financial management, Working capital management.		
Unit–III	**No. of Lectures: 06 Hours**	
Expansion strategies of an Enterprise: Expanding an enterprise : Expansion through concentration, Expansion through integration, Expansion through diversification, Expansion through cooperation, Expansion through internationalization, Expansion through digitalization,		
Unit–IV	**No. of Lectures: 6 Hours**	
Challenges for small Enterprises : Managerial problems, financial problems, Marketing problems ,Human resource problems, Technological problems Role of central and state governments in promoting small enterprises: Fiscal and tax concessions for small enterprises, Industrial policies for small enterprises		
Unit–V	**No. of Lectures: 06 Hours**	
Institutional Support for small enterprises : Institutions supporting small scale enterprises: Small scale industries (SSI) board, Khadi and village industries commission (KVIC), Micro, small and medium enterprises development organization (MSME-DO), National small industries corporation limited (NSIC), National institute for entrepreneurship and small business development (NIESBUD),, Indian institute of entrepreneurship (IIE), State industrial development / Investment Corporation (SIDCs/SIICs), State directorate of Industries (SDIs), District industry centers (DICs)		
Text Books:		
1. AlpanaTrehan,"Entrepreneurship"WileyIndisPvtLtd,2011. 2. JackM.Kaplan,"PatternsofEntrepreneurship"Wiley,2006.		
Reference Books:		
1. Poornima M. Charantimath, "Entrepreneurship Development - SmallBusiness Enterprises" Pearson. 2. ThomasW.Zimmerer&NormanM.Scarborough,"EssentialofEntrepreneurshipand Small BusinessManagement"4th Edition,Pearson.		
NPTEL Links: **1.** Entrepreneurship by Prof.C.Bhaktavatsala Rao, IIT, Madras https://archive.nptel.ac.in/courses/110/106/110106141 **2.** Models and Entrepreneurship by prof. vinay Sharma,IIT Roorkee https://archive.nptel.ac.in/courses/110/107/110107094/		
Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.		

ENVIRONMENTAL SCIENCES					
COURSE OUTLINE					
Course Title:	**ENVIRONMENTAL SCIENCES**	**Short Title:**	**EVS**	**Course Code:**	**EE - 411**

Course description:
The course aims to percolate the importance of environmental science and environmental studies.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	02

Prerequisite course(s):

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Integrate the knowledge on human interactions with the environment and problems associated with it
2. Analyze the importance of renewable and non-renewable natural resources
3. Learn the fundamentals of ecosystem
4. Learn and conserve the biodiversity and its conservation
5. Analyze the relation between social issues and the environment

Course outcomes:

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

1. Evaluate the effectiveness of various environmental policies and practice them as life-long learning
2. Develop the strategies for effective waste management and resource conservation
3. Articulate the interconnected, and interdisciplinary nature of environmental studies
4. Evaluate the local and global scale of environmental problems
5. Communicate complex environmental information to both technical and non-technical audiences.

COURSE CONTENT

ENVIRONMENTAL SCIENCES		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**End Semester Examination (ESE) UA:**	**25 marks**

Unit I	**No. of Lectures: 08 Hours**	**5 Marks**

Multidisciplinary Nature of Environmental Studies and Social Issues

Definition, scope and importance multidisciplinary nature of environmental studies and need for public awareness, From Un sustainable to Sustainable development, Water conservation, rain water harvesting, water shed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions.
Climate change, global warming, acid rain, ozone layer depletion, nuclear
Accidents and holocaust. Case Studies. Waste land reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act Wild life Protection Act Forest Conservation Act Issues involved in enforcement of environmental legislation. Public awareness.

Unit II	**No. of Lectures: 05 Hours**	**5 Marks**

Natural Resources

Renewable and non-renewable resources

Natural resources and associated problems.
Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people
Water resources: Use and over-utilization of surface and ground water, floods, drought,

conflicts over water, dams-benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
Role of an individual in conservation of natural resources.
Equitable use of resources for sustainable lifestyles

Unit III	**No. of Lectures: 08 Hours**	**5 Marks**

Ecosystems, Biodiversity and their Conservations

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the ecosystem like Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries), Introduction–Definition: genetic, species and ecosystem diversity, Bio geographic classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-sports of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

Unit IV	**No. of Lectures: 05 Hours**	**5 Marks**

Environmental Pollution

Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

Unit V	**No. of Lectures: 04 Hours**	**5 Marks**

Human, Population and the Environment

Population growth, variation among nations. Population explosion–Family Welfare Program, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Reference Books:

1. Agarwal, K. C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad – 380 013, India, Email: mapin@icenet.net (R)
3. BrunnerR.C.,1989, Hazardous Waste Incineration, McGrawHillInc.480p
4. Clark R. S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. De A. K. Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev. Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)

10. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
12. Mckinney, M. L. & School, R. M.1996.EnvironmentalSciencesystems&Solutions, Web Enhanced edition.639p.
13. Mhaskar A. K. Matter Hazardous, Techno-Science Publication (TB)
14. Miller T. G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
15. Odum, E. P.1971. Fundamentals of Ecology.W.B.SaundersCo.USA,574p
16. Rao M N. &Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
17. SharmaB.K.,2 001.Environmental Chemistry. Geol Publ. House, Meerut
18. Survey of the Environment, The Hindu (M)
19. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Second Year Bachelor Engineering

in

(Common for all)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE FOR OPEN ELECTIVE - II

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

Open Elective - II

A Student can opt for any one subject out of available institute wide subjects defined in the following list as Open Elective provided, he/she has not taken that particular subject in his/her Programme core, Programme elective, Multidisciplinary Minor, other Open elective and Vocational and Skill Enhancement courses etc. throughout his / her four years of UG Engineering Programme. The student must opt a subject that is compulsorily from faculty other than that of the Major discipline.

Course Code	Name of the Subject / Course	Faculty Offered by	Department Offered by
Open Elective - II (w.e.f. 2025 - 26 at Semester - IV, Second Year Engineering)			
OE – 407 A	Human Resource Management	Comm. & Mgmt.	Management
OE – 407 B	Logical Reasoning and Problem Solving	Sci. & Tech.	Mathematics
OE – 407 C	Retail Management	Comm. & Mgmt.	Commerce
OE – 407 D	Public Health and Hygiene	Sci. & Tech.	Zoology
OE – 407 E	Agricultural Pest Management	Sci. & Tech.	Zoology
OE – 407 F	Basics of Stock Markets	Comm. & Mgmt.	Commerce
OE – 407 G	Problems of Philosophy	Humanities	Philosophy
OE – 407 H	Social and Preventive Pharmacy	Sci. & Tech.	Pharmacy

HUMAN RESOURCE MANAGEMENT (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**HUMAN RESOURCE MANAGEMENT**	**Short Title:**	HRM	**Course Code:**	**OE – 407 A**

Course description:

This course provides a comprehensive understanding of Human Resource Management (HRM), including key functions such as talent acquisition, performance management, training and development, and compensation management. It also covers emerging trends like AI in HR, digital HR, people analytics and sustainable HRM practices.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. To understand the fundamental principles and functions of HRM.
2. To analyse workforce planning, recruitment, selection, and retention strategies.
3. To evaluate performance management systems, appraisal techniques, and key HR metrics.
4. To assess training and development programs to enhance employee skills and productivity.
5. To explore digital HR, work-life balance, compensation strategies, and sustainable HRM practices.

Course outcomes:

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

1. Explain HRM concepts and their significance in business operations.
2. Apply talent acquisition and retention strategies in an organizational context.
3. Implement performance appraisal and feedback systems effectively.
4. Develop employee training and development programs for career growth.
5. Utilize modern HR tools and technologies to enhance organizational efficiency.

COURSE CONTENT

HUMAN RESOURCE MANAGEMENT		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**4 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Basics of Human Resource Management

Introduction to HRM: Meaning, Definitions, Nature and Objectives,
Functions of HRM: Managerial and Operative Functions
Differences between HRM, Personnel Management, and HRD
Role of HR Managers: Skills, Qualities, and Future Challenges
Emerging Trends: AI in HR, Digital HR, and People Analytics

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Talent Acquisition and Management

Human Resource Planning (HRP): Concept, Need, Characteristics, Benefits, Process.
Recruitment: Concept, Purpose, Sources, and Process
Selection: Concept, Process, Selection Tests, and Barriers
Placement: Concept and Problems

Induction/Orientation: Concept, Objectives, Steps, Problems
Promotion, Demotion, Transfer, Layoff, Downsizing, Rightsizing, and
Voluntary Retirement Scheme (VRS)

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Performance Management and Appraisal

Performance Management: Concept, Objectives, and Modern Approaches
Performance Appraisal: Concept, Need, and Importance
Performance Appraisal: Traditional Methods and Modern Methods
Key Performance Indicators (KPIs) and Balanced Scorecard Approach
Bias in Performance Appraisal: Types and Ways to Mitigate
Legal and Ethical Issues in Performance Appraisal

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Training and Development

Definitions, Need, and Objectives of Training & Development
Concept and Importance of Executive Development
Training Methods: On-the-Job and Off-the-Job Methods, Virtual Learning and
E-Learning Platforms
Evaluating Training Effectiveness: Tools and Models
Difference between Training, Development, and Education
Career Development and Succession Planning

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Advanced HRM Practices

HRM in the Digital Age: HRIS (Human Resource Information System) and Digital Transformation
Work-Life Balance: Flexible Work Models, Hybrid Work, and Employee Wellbeing
Compensation Management: Wage and Salary Administration, Incentives, and Benefits
Sustainable HRM: Green HRM, Corporate Social Responsibility (CSR) in HR, and Ethical HRM

Text Books:

1. "Human Resource Management: Text and Cases" by Dr. V.S.P. Rao (Excel Books)

Reference Books:

1. Human Resource Management By Dr. Shikha Kapoor - Taxmann
2. Human Resource Management By Dr K. Ashwathappa – Tata McGraw Hill
3. Essentials of Human Resource Management By P. SubbaRao – Himalaya Publishing House
4. HR From the Outside In: Six Competencies for the Future of Human Resources –
5. Boudreau & Cascio - McGraw-Hill Education- ISBN: 978-0071790351

NPTEL Links:

1. Principles of HRM by Prof. Aradhna Malik
   https://archive.nptel.ac.in/courses/110/105/110105069/
2. Talent Acquisition and Management by Prof. Santosh Rangnekar
   http://kcl.digimat.in/nptel/courses/video/110107152/L19.html
3. Performance & Reward Management by Prof Susmita Mukhopadhyay
   https://archive.nptel.ac.in/courses/110/105/110105137/
4. Training and Development by Prof. Susmita Mukhopadhyay and Prof. S. Srinivasan
   https://onlinecourses.nptel.ac.in/noc22_hs63/preview

LOGICAL REASONING AND PROBLEM SOLVING (Open Elective – II)

COURSE OUTLINE

Course Title:	**LOGICAL REASONING AND PROBLEM SOLVING**	**Short Title:**	LRPS	**Course Code:**	**OE – 407 B**

Course description:

The Logical Reasoning course is designed to enhance a student's ability to think critically and make reasoned judgments through structured and logical thought processes. This course focuses on developing key skills required to analyze patterns, relationships, and arguments, which are essential for solving complex problems. Throughout the course, students will be exposed to various types of logical reasoning problems, including deductive and inductive reasoning, analogies, sequences, and puzzles.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. Course will provide an introduction to logical and philosophical reasoning.
2. To enhance the analytical skill and problem solving skill of the students.
3. To improve verbal and non-verbal reasoning ability skill of the students

Course outcomes:

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

1. Choose analogy and classification, and perform coding and decoding on data
2. Evaluate arguments, identify assumptions, and recognize logical fallacies, strengthening their ability to think critically and make informed decisions.
3. Recognize logical reasoning applicable to real-life situations and solve real-life problems
4. Apply critical thinking in analyzing number patterns, ranks, and time sequences, fostering decision-making skills that are crucial for problem-solving.
5. Develop the ability to identify and interpret visual patterns and sequences.

COURSE CONTENT

LOGICAL REASONING AND PROBLEM SOLVING		**Semester:**	**IV**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Analogy : Completing the analogous pair, Direct/ Simple Analogy, Choosing the analogous pair, Double Analogy Choosing a similar word, Detecting Analogies, Multiple word analogy, Number analogy, Alphabet Analogy

Classification : Choosing the odd word, Choosing the odd pair of word, Choosing the odd numeral, Choosing the odd numeral pair/ group

Coding and Decoding : Letter coding, Direst letter coding, Number/ Symbol Coding, Matrix Coding , Substitution, Deciphering message word codes, Deciphering number and symbol codes for messages.

Blood relations: Deciphering jumbled up descriptions, Relation puzzle, Coded relations		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Direction sense Test : Directions and Cardinal Directions , Direction puzzle **Logical Sequence of words :** Sequence in process , Sequence in object formation **Data Sufficiency** : Yes/No Questions, Value Questions **Verification of Truth of the Statement:** Relationship with the thing mentioned. **Sequential Output Tracing**		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Logic : Logical Reasoning, Logical Deduction , Two- Premise Arguments, Three-Premise Arguments **Statement – Arguments :** Strong arguments and weak Arguments **Statement –assumption :** Type 1- implicit statement, Type2-Implicit in Context **Statement –Conclusions :** Direct / indirect implications of conclusions **Cause and Effect Reasoning**		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Logical Venn Diagrams: Type 1, Type 2 **Number, Ranking and Time Sequence Test:** Type 1: Number Test, Type 2: Ranking Test, Type 3: Time Sequence Test **Mathematical Operations** Type 1: Problem-Solving by Substitution, Type 2: Interchange of Signs and Numbers, Type 3: Deriving the Appropriate Conclusions **Arithmetical Reasoning:** Type 1: Calculation-Based Problems, Type 2: Data-Based Questions, Type 3: Problems on Ages, Type 4: Venn-Diagram Based Questions		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
NON-VERBAL REASONING: **Classification:** Choosing the Odd Figure, Choosing a Similar Figure, Finding Figures with the Same Characteristics, **Analytical Reasoning** **Mirror-Images** : Mirror-Images of Capital letters, Small letters, Numbers and figures **Water-Images :** Water-Images of Capital letters, Small letters, Numbers and figures **Cubes and Dice :** 2D and 3D cubes, Number opened dice and Letter opened dice		
Text Books:		
1. Dr. R.S. Aggarwal "A Modern Approach to Verbal & Non-Verbal Reasoning" by S. Chand Publication.		

RETAIL MANAGEMENT (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**RETAIL MANAGEMENT**	**Short Title:**	RM	**Course Code:**	**OE – 407 C**

Course description:

This course provides an in-depth understanding of retail management, covering key concepts such as retail formats, consumer behavior, supply chain management, and e-retailing. It explores the role of technology in retail, sustainable business practices, and emerging retail trends. The course equips students with the knowledge and skills required to manage retail operations efficiently and explore entrepreneurial opportunities in the retail sector.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

6. Understand the fundamentals of retailing, consumer behavior, and key retail formats.
7. Analyze retail operations, supply chain management, and technology integration in retail.
8. Apply e-retailing strategies and digital innovations to enhance customer experience.
9. Evaluate sustainable and ethical retail practices and their impact on business.
10. Develop entrepreneurial skills by exploring emerging trends and business opportunities in retail.

Course outcomes:

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

1. Explain the core concepts, significance, and evolution of retailing.
2. Analyze retail supply chain, store operations, and digital retail transformations.
3. Apply technology-driven solutions like AI, IOT, and block chain in retail management.
4. Evaluate sustainable retail models and ethical business practices.
5. Develop innovative retail business strategies and entrepreneurial ventures.

COURSE CONTENT

RETAIL MANAGEMENT		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Retailing

Retailing: Definition, significance, and evolution
Retail formats, business models, and ownership structures
Consumer behavior and purchase decision-making
Key drivers of retail growth in India and globally

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Retail Organization and Supply Chain Management

Store location, layout, and visual merchandising
Inventory control, logistics, and warehouse management
POS systems, cash handling,

Role of automation in retail operations		
Unit-III	**No. of Lectures: 09 Hours**	**Marks: 12**
E-Retailing and Digital Transformation		
Growth of e-commerce and omnichannel retailing AI, IoT, and blockchain applications in retail Customer data management and personalized marketing strategies Role of AR/VR in enhancing customer experience Cybersecurity and data privacy in online retailing		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Sustainable and Ethical Retailing		
Sustainability and green retailing practices Ethical sourcing and fair trade in retail Waste management and circular economy in retail Impact of government policies and regulations on retailing		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Future Trends and Entrepreneurship in Retail		
Retail analytics and business intelligence for decision-making Startups and innovation in retail entrepreneurship Franchising and global retail expansion Emerging trends: Quick commerce, Direct-to-Consumer (DTC) models Case studies on innovative retail success stories		
Text Books:		
1. "Retailing Management – Text and Case" (7th Edition) by Swapna Pradhan, Tata McGraw Hill		
Reference Books:		
1. Suja Nair, Retail Management, 2011 Edition, Generic, 2015. 2. R. S. Tiwari, Retail Management, Himalaya Publishing House. 3. Francois Chaubard, AI for Retail: A Practical Guide to Modernize Your Retail Business with AI and Automation, Wiley, 2023 4. Michael Levy, Barton A. Weitz and, Dhruv Grewal Professor Retailing Management, McGraw Hill; 10th edition (4 January 2018) 5. Gibson G. Vedamani, "Retail Management- Functional Principles and Practices", Jaico Publishing House, Mumbai.		
NPTEL Links: 1. Retail Management by By Prof. Swagato Chatterjee, IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc25_mg56/preview		

PUBLIC HEALTH AND HYGIENE (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**PUBLIC HEALTH AND HYGIENE**	**Short Title:**	**PHH**	**Course Code:**	**OE – 407 D**

Course description:

This course provides a comprehensive understanding of public health and hygiene practices, exploring their significance in preventing disease, promoting well-being, and improving the quality of life for individuals and communities. Students will learn about the principles and strategies involved in maintaining public health, the role of hygiene in disease prevention, and the impact of environmental and behavioral factors on health.

	Hours/week	No. of weeks	Total hours	Semester credits
Lecture	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. Gain knowledge of common food-borne and water-borne diseases (causes, symptoms, transmission), and apply strategies for prevention and control.
2. To impart basic and technical knowledge on nursery management for strengthening of horticulture sector.
3. To study the disease and pest controlling nursery with practical experience.

Course outcomes:

1. Demonstrate the ability to design balanced meal plans considering calorie needs and dietary requirements for different individuals and life stages.
2. Effectively communicate the causes, symptoms, and prevention strategies for common food-borne and water-borne diseases.
3. Competently demonstrate essential personal hygiene practices and advocate for social hygiene initiatives in the community.
4. Articulate the negative health consequences of unhealthy habits and positively promote physical activities like cycling and walking, stress management techniques (yoga), and responsible family planning methods.
5. Develop an understanding of nutrition principles, balanced diets, and dietary needs for different life stages (infants, children, adults, pregnancy, lactation), promoting healthy eating practices for disease prevention.

COURSE CONTENT

PUBLIC HEALTH AND HYGIENE		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Nutrition and health:

Introduction: Scope and importance of Public health and hygiene. Balanced diet, diet control for diabetics and cholesterol, etc. Concept of energy, calories, daily food intake as per occupation, pregnancy and lactation. Dietary requirements of infants, pre-school children, schoolchildren, adults.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Health Hazards:		
Health dynamicity – definition, factors influencing health, health as a medium of socio-economic development. Diseases – Common food borne and water borne diseases (jaundice, cholera, diarrhea and typhoid) – causative agents, symptoms, mode of transmission, prevention and control.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Health hygiene:		
Personal hygiene, body odour, oral hygiene and sexual hygiene, grooming, feminine hygiene, sleep hygiene, hand washing, toiletry. Social hygiene – clean living movements, occupational hygiene, food and cooking hygiene, medical hygiene, excessive hygiene.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Health Education:		
Definition, objectives, principles ,effects of smoking, alcoholism and drug abuse (hashish, opium, brown sugar).Population control and family welfare- use of contraceptives Importance of Body fitness Importance of cycling and walking exercise. Stress reduction management – Importance of yoga Sickle Cell Disorder.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Healthy Lifestyle:		
Lifestyle habits ,Balanced Diet , Stress Management**,** Benefits of a Healthy Lifestyle, Excessive usage of T.V., computer, mobile phones, two wheelers, and their impacts on health.		
Text Books:		
1. "Essentials of Public Health and Sanitation – Part I- IV" by Jatin V. Modi and Renjith S. Chawan.		
Reference Books:		
1. Murray, C. J. L. and A.D. Lopez. (1996), The Global Burden Of Disease. World Health Organization. 2. Park, J.E. and Park, K. Textbook of Community Health for Nurses. 3. Swaminathan S. Principles of Nutrition and Dietetics.		
NPTEL Links: 1. **One Health-**By One Health InstructorsICMR - Regional Medical Research Centre, Bhubanesw (One Health - Course (nptel.ac.in) 2. **Basics of Health Promotion and Education Intervention** By Dr. Arista Lahiri, Dr. Sweety Suman Jha, Dr. Madhumita Dobe, Dr. Chandrashekhar Taklikar | IIT Kharagpur, IIT Kharagpur, AIIH&PH, Kolkata, AIIH&PH, Kolkata (Basics of Health Promotion and Education Intervention - Course (nptel.ac.in))		

AGRICULTURAL PEST MANAGEMENT (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**AGRICULTURAL PEST MANAGEMENT**	**Short Title:**	APM	**Course Code:**	**OE – 407 E**

Course description:

This course provides a comprehensive understanding of the tactics and practices of managing pests in agricultural systems. It covers the identification, biology, and ecology of common agricultural pests. Students will learn integrated pest management (IPM) strategies that combine biological, cultural, physical, and chemical control methods to minimize pest damage while promoting environmental sustainability and economic viability**.**

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Biology, Environmental Science

Course objectives:

The objective of this course is to:

1. To understand agricultural pest management.
2. To learn economic impacts of integrated pest management and decision making.
3. To improve the biological precepts and sampling for detection convey.
4. To learn management of insect pests of cotton and rice.
5. To understand management of insect pests of vegetable crops and oilseeds.

Course outcomes:

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

1. Apply the concept of agricultural pest management.
2. Co-relate the economic impacts of integrated pest management and decision making.
3. Acquire skill of the biological precepts and sampling for detection.
4. Illustrate the management of insect pests of Cotton and rice.
5. Demonstrate and analyse the management of insect pests of vegetable crops and oilseeds.

COURSE CONTENT

AGRICULTURAL PEST MANAGEMENT		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

The IPM paradigm: concepts, strategies and tactics and Economic impacts of IPM

Historical perspectives, Early conceptual efforts in Integrated Pest Management (IPM} development, Kinds of pests, Pest management strategies and tactics, Funding IPM research and implementation, Measuring IPM implementation. Economic impacts of IPM: Measuring IPM adoption, Individual economic impacts to the IPM user, Analyzing typical adoption cases using budgets, Analyzing optimal IPM decisions, Aggregate or market-level economic impacts of IPM, 1 Capturing price effects when IPM impacts are large, Aggregating economic impacts over time, Valuing health and environmental impacts.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Economic decision rules for IPM and Decision making and economic risk in IPM

Economic decision rules for IPM: Economic decision levels, The EIL, The ET, Development of EILs and ETs, Current approaches, Limitations to EILs and ETs. Decision making and economic risk in IPM: Defining IPM within a management context, Economic injury level (EIL) and economic threshold (ET), Risk and IPM, Representing risky situations, Decision making criteria and tools, Risk preferences defined.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

IPM as applied ecology-the biological precepts and Sampling for detection, estimation and IPM decision making

IPM as applied ecology-the biological precepts: Life systems, Pest population dynamics, Stochastic models and meta populations, Population structure and life tables, Population stability and species diversity, Open and closed ecosystems, Scale and ecologically based pest management Sampling for detection, estimation and IPM decision making: Basics of sampling, Necessary sample size, Detection sampling, Estimation sampling, Decision sampling.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Management of Insect Pest of Cotton and Rice

Management of Insect Pests of Cotton: Introduction Changing Insect Pest Scenario, Cultural, Mechanical, and Physical Control, Microbial Control, Biological Control, Botanical Control, Chemical Control, Integrated Pest Management. Management of Insect Pests of Rice: Introduction, Component of Integrated Pest Management, Cultural Methods, Biological Control, Behavior modifying chemicals, Botanical Bio pesticides.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Management of Insect Pests of Vegetable Crops and Oilseeds

Management of Insect Pests of Vegetable Crops in Net House: Introduction, Physical Control, Cultural Control, Mechanical Control, Biological Control, Botanical Control. Management of Insect Pests of Oilseeds Crops: Rapeseed-Mustard, Sunflower, Groundnut, Sesamum, Linseed.

Textbooks:

1. "Integrated Pest Management, Concepts, Tactics, Strategies and Case Studies" by Edward B. Radcliffe, William D. Hutchison, Rafael E. Cancelado, Cambridge Publishing.
2. “Theory and Practice of Integrated Pest Management” by Ramesh Arora, Balwinder Singh, A.K. Dhawan, Scientific Publisher.

Reference Books:

1. “Integrated Pest Management for Crops and Pastures” by Paul Horne, Jessica Page, Land Links Publishing
2. “Encyclopedia of Pest Management” Volume II, by Devid Pimentel, CRC Press Taylor and Francis Group Publishing.

NPTEL Links:

1. Integrated Pest Management (IPM) by IIT Kanpur.
   https://archive.nptel.ac.in/courses/126/104/126104003/

BASICS OF STOCK MARKETS (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**BASICS OF STOCK MARKETS**	**Short Title:**	BSM	**Course Code:**	**OE – 407 F**

Course description:

This course introduces students to the fundamental concepts of stock markets, investment avenues, and trading mechanisms. It covers the structure and functioning of Indian financial markets, types of securities, stock trading strategies, mutual funds, and regulatory frameworks. The course also emphasizes investor protection measures, risk management, and financial literacy to enable informed decision-making in stock market investments.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Remember and define the fundamental concepts of stock markets and various investment instruments.
2. Understand the structure, organization, and functioning of financial markets in India.
3. Apply knowledge of primary and secondary market operations, trading mechanisms, and investment avenues.
4. Analyze stock trading strategies, risk-return factors, and investor protection measures.
5. Evaluate the role of regulatory bodies and ethical investment practices in the stock market.

Course outcomes:

1. After successful completion of this course the student will be able to:
2. Describe the functioning and significance of stock markets in the Indian financial system.
3. Classify different types of investment instruments and explain their characteristics.
4. Examine stock trading mechanisms, market indices, and risk-return factors.
5. Develop basic investment strategies and assess stock market operations.

COURSE CONTENT

BASICS OF STOCK MARKETS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction

Saving vs Investment – Understanding the Need for Investment
Types of Investment Instruments – Equity Shares, Preference Shares, Bonds, Debentures, Government Securities, Sovereign Gold Bonds
Overview of Stock Exchanges – BSE, NSE & Their Indices
Difference Between Trading & Investment in Stock Market

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Types of Market and Derivatives

Types of Markets – Primary & Secondary Markets
Primary Market – IPO, Credit Rating Agencies, Underwriting, Grey Market

Secondary Market – Stock Brokers, Sub Brokers, Listing of Shares, Depositories
Basics of Derivatives – Futures, Options, Call & Put, Commodity & Financial Derivatives

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Mutual Funds and Investment Avenues

Concept and Advantages of Mutual Funds
Types of Mutual Funds – Equity, Debt, Liquid, Hybrid, Growth, Income, Tax-Saving, Pension Funds
Role of Asset Management Companies (AMCs) and Fund Managers
Factors to Consider Before Investing in Mutual Funds

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Stock Trading and Investment Strategies

Basics of Stock Trading – How to Open a Demat & Trading Account
Stock Order Types – Market Order, Limit Order, Stop Loss, Intraday Trading
Understanding Stock Market Indices and Their Importance
Risk & Return Analysis – Concept of Diversification, Systematic vs. Unsystematic Risk

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Regulatory Framework & Investor Protection

Role of SEBI (Securities and Exchange Board of India) in Stock Market Regulation
Investor Protection Mechanisms – Grievance Redressal, Investor Rights & Duties
Common Stock Market Frauds & Scams – Insider Trading, Pump & Dump Schemes
Overview of Taxation on Stock Market Investments – Capital Gains Tax, Securities Transaction Tax

Text Books:

1. Prasanna Chandra, “Investment Analysis and Portfolio management”, Tata McGraw Hill,3rd Edn., 2008
2. Julian Walmsley, “New Financial Instruments”, John Wiley & Sons, 2nd edition, Inc 1998
3. PunithavathyPandian, Security Analysis and Portfolio Management, 2nd edition, Vikas Publishing House Pvt. Ltd., 2013
4. Dhanesh Khatri, Security Analysis and Portfolio Management, 1st edition, MacMillan Publishers, 2010

Reference Books:

1. Bharati V. Pathak, “ The Indian Financial System: Markets, Institutions and Services”, Pearson education, 3rd edn.
2. Bhole I. M.: “Financial Markets and Institutionals”: Tata McGraw Hill, New Delhi.
3. Chandler M. V. and Goldfeld S. M: Economics of Money and Banking: Harper and Row, New York.
4. Edwin J. Elton, Martin J. Gruber, Modern Portfolio Theory and Investment Analysis, 8 th edition, John Wiley & Sons, 2010
5. SEBI Manual, 33rd edition, Taxmann Publications, 2019
6. Shashi K Gupta, Security Analysis Portfolio Management, 1st edition, Kalyani Publishers, 2010

NPTEL Links:

1. **Financial Institution and Market**
   https://archive.nptel.ac.in/courses/110/105/110105121/

PROBLEMS OF PHILOSOPHY (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**PROBLEMS OF PHILOSOPHY**	**Short Title:**	POP	**Course Code:**	**OE – 407 G**

Course description:

This course explores some of the central questions and issues in philosophy, designed to introduce students to fundamental philosophical problems and to develop their critical thinking skills. The course covers a broad range of topics, including metaphysics, epistemology, ethics, philosophy of mind, philosophy of language, and political philosophy. Students will examine classic and contemporary texts by influential philosophers, critically analyze their arguments, and engage with different philosophical traditions.

	Hours/week	No. of weeks	Total hours	Semester credits
Lecture	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. To provide knowledge of philosophical Theories
2. To create awareness about Indian and western Philosophy .
3. To understand Theory's Problem of Change, Problem of Self,Problem of Values
4. To understanding various Self of Philosophy
5. Help students understand key ethical dilemmas and encourage thinking about how philosophy informs moral decisions, ethical theory, and the application of ethical principles in real-world situations.

Course outcomes:

1. Students will understand knowledge of philosophical Theories
2. Students will understand about Problem of Change, Problem of Self.
3. Students will to understand Values
4. Students will to understand theory of causation
5. Developing the ability to critically analyze and evaluate philosophical arguments, identifying strengths and weaknesses in reasoning.

COURSE CONTENT

PROBLEMS OF PHILOSOPHY		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Nature of Philosophy:

Concept and definition of Philosophy according to Empiricism, Rationalism, Advait Vedanta, Buddhism. Scope of Philosophy in relation to Natural Sciences, Social Sciences, Political Science, Economics and Sociology, Religion.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Problem of Knowledge:

Western approach of Empiricism and Rationalism (Locke and Leinbnitz) , Indian approach of Empiricism and Rationalism (Charvaka and Nyaya) ,Sources of knowledge, Perception , Inference , Intuition , Testimony.

Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**

Problem of Change:		
Concept of change and permanence , Theories of change and causation Satkaryavad (Samkhya) Arambhavada (Nyaya), Aristotle's four fold theory of causation, Hume's theory of causation, and Mill's concept of causation.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Problem of Self		
Nature of Self, Concept of self-according to Plato ,Descartes ,Samkhya ,Buddhism		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Problem of Values		
Nature of values and their role in human life, Kinds of values ,Moral ,Aesthetic Problem of Truth, Correspondence Theory of Truth ,Coherence Theory of Truth ,Pragmatic Theory of Truth.		
Text Books:		
1. "The problems of philosophy" by Russell, B. (1959) New York, Oxford University Press.		
Reference Books:		
1. Moore G. E.-Some Main Problemsof Philosophy 2. Durant Will-The Pleasures of Philosophy 3. Hawking W. E- Types of Philosophy 4. Ewing A. C.-The Fundamental Questions of Philosophy 5. Ayer A. J.-The Central Questions of Philosophy		
NPTEL Links: 1. **Philosophy and Critical Thinking-**By Prof. Gyan Prakash | Indian Institute of Technology (Indian School of Mines), Dhanbad, India Philosophy and Critical Thinking - Course (nptel.ac.in) 2. **Indian Philosophy-Prof. Satya Sundar Sethy** is a Professor in the Department of Humanities and Social Sciences, IIT Madras. Indian Philosophy - Course (nptel.ac.in)		

SOCIAL & PREVENTIVE PHARMACY (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**SOCIAL & PREVENTIVE PHARMACY**	**Short Title:**	SPP	**Course Code:**	**OE – 407 H**

Course description:

This course is designed to impart basic knowledge on public health, epidemiology, preventive care and other social health related concepts. Also, to emphasize the roles of students in the public health programs.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. The objective of this course is to:
2. Preventive healthcare.
3. Public health and national health programs.
4. Food and nutrition related health issues.
5. Health education & social promotion of maintenance of health.

Course outcomes:

1. After successful completion of this course the student will be able to:
2. Describe various sources of health hazards and disease preventive measures.
3. Discuss the health care issues associated with food and nutritional substances.
4. Describe the general roles and responsibilities of students in public health.
5. Create awareness so that health status of society can be raised.

COURSE CONTENT

SOCIAL & PREVENTIVE PHARMACY		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to social Pharmacy

Definition & Scope: Social Pharmacy as a discipline & its scope in improving public health. Concept of health: WHO definition, various dimensions, determinants and health indicators. Public and private health system in India, national health mission.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Environment and Health

Water pollution, importance of safe drinking water, waterborne diseases, air pollution, noise pollution, sewage and solid waste disposal, occupational illness. Psychosocial Pharmacy: Drugs of misuse and abuse- psychotropic, narcotics, alcohol, tobacco products. Social impact of these habits on social health and productivity and suicidal behaviors.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

First Aid

Need for emergency treatment, emergency treatment in shock, snake bite, burns, poisoning, fractures, resuscitation methods.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Nutrition and Health

Basics of nutrition: Macronutrients and Micronutrients, Importance of water & fiber in diet, Balanced diet, Malnutrition, nutrition deficiency diseases, ill effects of junk foods, caloric & nutrients values of various foods, fortification of food, Introduction to food safety, adulteration of foods, effects of artificial ripening, use of pesticides, genetically modified foods, Dietary supplements, nutraceuticals, food supplements, indications, benefits, Drug –Food interactions.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Epidemiology

Introduction to epidemiology, and its applications. Understanding the terms epidemic, pandemic, endemic, mode of transmission, outbreak, quarantine, isolation, incubation period, contact tracing, morbidity, mortality, Causative agents, mode of transmission and prevention of following communicable diseases, Respiratory infections- Mumps, Influenza(including Avian-Flu, H1N1, SARA,COVID-19), whooping cough, tuberculosis., Intestinal infections- Viral hepatitis, acute diarrheal disease, typhoid, food poisoning, Arthropod-borne disease- dengue, malaria, chikungunya, STDs, HIV/AIDS.

Text Books:

1. New approach to Social Pharmacy, S.P.S. Khurana Pee Vee publications.
2. A text book of Health Education & Community Pharmacy, Dr. Anees Siddique, Birla publications

Reference Books:

1. Social Pharmacy: Tayler, Geoffrey. Pharmaceutical Press. London.
2. Social Pharmacy: Innovation and Development. Geoff Harding, Sarah Nettleton and Kevin Taylor. The Pharmaceutical Press.
3. Community Pharmacy Handbook- Jonathan Waterfield.
4. Essentials of Community Medicine- Apracical approach, Hiremath Lalita D, Hiremath Dhananjaya A 2nd Edition, 2012,ISBN: 9789350250440, JAYPEE Publications.

EXIT COURSE

Internship / Apprenticeship:

Internship / Apprenticeship / OJT shall be corresponding to the programme (Major) subject. Internship / Apprenticeship / OJT shall be monitored jointly by faculty and Industry / organization mentor.

The role of a Mentor, nominated by institute, shall be to provide professional/research guidance to the student during the internship. They shall also facilitate networking with other subject matter experts/professionals, which will enhance the internship experience and learning of the students.

Internship / Apprenticeship / OJT corresponding to the programme (Major) subject in Exit course with an external organization / entity is desirable. External organization may be industries, research institutions, University research centers or CSIR laboratories. Internship / Apprenticeship / OJT shall be preferably in offline mode, however online mode may also be permitted.

Preferably the Mini Project in Exit course shall be based on Internship / Apprenticeship / OJT.

Activities under Internship / Apprenticeship / OJT include Project work, Seminar, Industrial Training (excluding credits for Advanced Courses). This can be Industrial / Govt. / NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship / academic / industry research project.

After completion of Internship, students shall prepare a comprehensive report highlighting their learnings and takeaways during the internship period. The students are mandated to give a seminar based on the internship undertaken before an expert committee constituted by the concerned department and the assessment of internship shall be based on the following criteria:

1) Quality and effectiveness of presentation
2) Depth of knowledge and demonstrated skills
3) Variety and relevance of learning experience
4) Practical applications and relationships with concepts taught in the course
5) Internship Report
6) Attendance record, student diary (log), supervisor evaluation

Attendance record shall include daily attendance with IN and OUT time. It shall be signed by Industry supervisor.

Student Diary (log) shall include daily activities carried out by the student during Internship with Task assigned, Activities performed, key learnings etc. It shall be signed by Industry supervisor.

Supervisor evaluation form shall include the following with ratings in FIVE-point scale.

1) Behaviours
2) Performs in a dependable manner
3) Cooperates with co-workers and supervisors
4) Shows interest in work
5) Learns quickly
6) Shows initiative
7) Produces high quality work
8) Accepts responsibility
9) Accepts criticism
10) Demonstrates organizational skills
11) Uses technical knowledge and expertise
12) Shows good judgment
13) Demonstrates creativity/originality
14) Analyzes problems effectively
15) Is self-reliant
16) Communicates well
17) Writes effectively
18) Has a professional attitude
19) Gives a professional appearance
20) Is punctual
21) Uses time effectively

Supervisor evaluation form shall be signed by Industry supervisor.

Mini project:
The student shall carry out a Mini project based on the knowledge acquired during the degree course and/or Internship. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the guide / mentor / department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship. The project may also be a sponsored project. The project shall be corresponding to the programme (Major) subject.
Upon completion of the Mini project, the student shall submit project report in the form of hard bound. Assessment for the Mini project shall also include presentation by the student. Assessment of Mini project shall be based on the following criteria:

1) Problem Identification / Project Objectives
2) Methodology / Design
3) Implementation
4) Results and Discussion
5) Conclusion
6) Report
7) Depth of Understanding
8) Presentation
9) Demonstration of the project

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Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY,
JALGAON (M.S.)

Bachelor of Engineering – Honors
in
High Voltage and Power Systems Engineering
for Second Year Bachelor of Engineering
in
Electrical
(As per NEP 2020 Guidelines)

Faculty of Science and Technology



SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Honors in High Voltage and Power Systems Engineering

Syllabus Structure for Honors in High Voltage and Power Systems Engineering: Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -311A	Electrical Engineering Material and Application	PCC	3			3	40	60			100	3
EE -312A	Electrical Engineering Material and Application Lab	PCC			2	2			25	25 (OR)	50	1

Syllabus Structure for Honors in High Voltage and Power Systems Engineering: Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -414A	High Voltage Measurement and Instruments	PCC	3			3	40	60			100	3
EE -415A	High Voltage Measurement and Instruments Lab	PCC			2	2			25	25 (OR)	50	1

ELECTRICAL ENGINEERING MATERIALS & APPLICATION (Honors) (PCC)					
COURSE OUTLINE					
Course Title:	**ELECTRICAL ENGINEERING MATERIALS & APPLICATION**	**Short Title:**	EEMA	**Course Code:**	**EE311 A**

Course description:
Explore laws, forces, and matter properties while studying the motion of charges in electric and magnetic fields. Hands-on demonstrations reinforce theoretical concepts, enhancing problem-solving skills and preparing students for diverse industry opportunities. Gain practical insights and unlock a world of career possibilities in this dynamic physics course.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Physic at 12th and First Year Engineering

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Explain classification, properties and characteristics of electrical engineering materials.
2. Describe applications and measuring methods for parameters of dielectric, insulating, magnetic, conducting and resistive materials.
3. Illustrate solving of simple problems based on dielectric, magnetic and conducting materials.
4. Demonstrate testing methods of dielectric, insulating, magnetic, conducting and resistive materials as per IS.

Course outcomes:

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

1. Discuss classification, electrical and thermal properties and characteristics of different electrical engineering materials conducting, semiconducting, insulating and magnetic materials for the manufacturing of electrical machines and electronic components.
2. State various applications and measuring methods for parameters of different classes of electrical engineering materials.
3. Solve simple problems based on dielectric, magnetic and conducting materials.
4. Execute tests on dielectric, insulating, magnetic, conducting, resistive materials as per IS to decide the quality of the materials.
5. Recognize the materials used for solar photovoltaic systems and nanotechnology.

COURSE CONTENT

ELECTRICAL ENGINEERING MATERIALS & APPLICATION		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Conductors: High conductivity, high resistivity materials, Mobility of electron in metals, Factors affecting conductivity and resistivity of electrical material.
Thermoelectric Effect: See back effect, Peltier effect, Thomson effect. Commonly used high conducting and high resistive materials, properties, characteristics and applications for AC and DC machines. Testing of materials as per IS to decide the quality of the materials.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Dielectric Materials:
Dielectric Properties of Insulating Materials: Static Field, Parameters of Dielectric material Introduction to Polar and Non- Polar dielectric materials. Mechanisms of Polarizations, Ferro-Electric Materials, Dielectric loss and loss tangent.
Dielectric Breakdown: Introduction, Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid and Gaseous dielectric materials. Testing of materials as per IS to decide the quality of the materials.

Unit–III	No. of Lectures: 09 Hours	Marks: 12

Insulating Materials, Properties & Applications: Introduction, Characteristics of Good Insulating Material, Classification. Solid, Liquid and Gaseous insulating material's characteristics and properties. Thermal Classification of insulating materials and applications.
Non ceramic insulators performance-service experience, Pollution/contamination flashover phenomena. Failures, importance of reliability. Insulating Materials for Power and Distribution Transformers, Rotating Machines (AC and DC machines), Capacitors, Cables and Switchgears. Testing of materials as per IS to decide the quality of the materials.

Unit–IV	No. of Lectures: 09 Hours	Marks: 12

Magnetic Materials, Semiconductors and Superconductors :
Magnetic Materials: Basic terms, Classification of magnetic material on the basis of dipole moment. Hysteresis loop, Magneto-striction effect, factors affecting permeability and hysteresis loss. Common magnetic materials, Soft and hard magnetic materials. Study of B-H curve for selection of materials.
Semi-Conductors and Superconductors: Materials for Electronic Components - Resistors, Capacitors, Inductors, Relays, Bipolar transistors, FET, Integrated circuits, Power devices. Hall effect Superconductors: Superconductivity, Properties of Superconductors, Meissner effect, Type-I and type-II Superconductors.

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Modern Engineering Materials:
Nanotechnology: Introduction, Concepts of Energy bands and various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and Nano-devices, applications
Solar/Photovoltaic Cell- Introduction, Photo generation of charge carriers, p-n junction, Light absorbing materials: Silicon thin films, concentrating photovoltaic.

Text Books:

1. S. P. Seth and P. V. Gupta, "A course in Electrical Engineering Materials", Dhanpat Rai Publication, 3rd edition.
2. C. S. Indulkar and S. Thiruvengadam, "Electrical Engineering Materials", S Chand Publication, 1st edition.

Reference Books:

1. R. K. Rajput, "Electrical Engineering Materials", Laxmi Publication, 2nd edition.
2. S. P. Chaitra and B. K. Bhatt, "Electrical Engineering Materials", Khanna Publication
3. N. Algappan and N. T. Kumar, " Electrical Engineering Materials" , T.T.T.I. Madras, TMH, 34th edition.
4. Charles P. Poole, Jr. Frank & J. Ownes , "Introduction to Nanotechnology" by (Wiley Student Edition)
5. A. J. Dekker, "Electrical Engineering Materials", PHI Pvt. Ltd.

NPTEL Links:

1. Semiconductors by Prof. S.K. Gupta, https://www.nptelvideos.com/lecture.php?id=1314.

2. Fundamentals and Applications of Dielectric Ceramics by Dr. Ashish Garg, https://nptel.ac.in/courses/113104090
3. Concept in Magnetism and superconductivity by Prof Arghya Taraphder, https://archive.nptel.ac.in/courses/115/105/115105131/#
4. Metallurgy and Material Science by Prof. Prathap Haridoss https://archive.nptel.ac.in/courses/113/106/113106039/
5. Nano-Technology Science and Application by Prof. Prathap Haridoss, https://archive.nptel.ac.in/courses/113/106/113106093/

ELECTRICAL ENGINEERING MATERIALS & APPLICATION LAB (Honors) (PCC)					
LAB COURSE CONTENT					
ELECTRICAL ENGINEERING MATERIALS & APPLICATION LAB		**Semester:**	**III**	**Course Code:**	**EE312A**
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: OR**			**25 marks**
		Internal Continuous Assessment (ICA) CA:			**25 marks**
End Semester Exam (ESE) Pattern:		**(Oral) OR**			

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Testing of insulating oil as per IS
2. Testing of solid insulating materials as per IS
3. Testing of power capacitors as per IS
4. Measurements of resistivity of conducting materials.
5. Measurements of resistivity of resistive material.
6. Study and use of Gauss meter.
7. To study See back and Peltier effects.
8. Study of hysteresis loop of ferromagnetic materials.
9. Study of various insulating materials.

Text Books:

1. S. P. Seth and P. V. Gupta, “A course in Electrical Engineering Materials”, Dhanpat Rai Publication, 3rd edition.
2. C. S. Indulkar and S. Thiruvengadam, “Electrical Engineering Materials”, S Chand Publication, 1st edition.

Reference Books:

1. R. K. Rajput, “Electrical Engineering Materials”, Laxmi Publication, 2nd edition.
2. S. P. Chaitra and B. K. Bhatt, “Electrical Engineering Materials”, Khanna Publication

Text Books:

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral

HIGH VOLTAGE MEASUREMENT AND INSTRUMENTS (Honors) (PCC)					
COURSE OUTLINE					
Course Title:	**HIGH VOLTAGE MEASUREMENT AND INSTRUMENTS**	**Short Title:**	**HVMI**	**Course Code:**	**EE414 A**

Course description: The course explores measurement of voltage, current and energy in EHV transmission network using current and potential transformer. The course highlights the error and it's caused in measurement. The course also introduces the testing methods and application of instruments. It discusses EHV laboratory equipment and testing with application of digital recorders.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Physic at 12th and First Year Engineering

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand the application of current and potential transformer for measurement in high voltage network.
2. Explain the high voltage testing methods and safety measures.
3. Understand the specification of measuring instruments for high voltage network.
4. Draw lab layout for high voltage testing labs installation.
5. Use IoT for emerging field of electrical measurements.

Course outcomes:

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

1. Explain the measurement procedure in high voltage network.
2. Decide testing methods for different components in high voltage network.
3. Identify advantage and errors in measurement in view of safety.
4. Analyze the measured data to solve engineering problems.
5. Use modern of IoT base instrument for modernization of EHV substation.

COURSE CONTENT

HIGH VOLTAGE MEASUREMENT AND INSTRUMENTS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Current Transformer and Potential Transformer Errors : Introduction , CT Construction, Measurement CT and Protective CT, Steady state Ratio and Phase angle Errors, Transient Error in CT, Transient Errors in CVT, Saturation of CT, CT Accuracy Classification

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Measurement of High Voltages and Currents : Introduction, Sphere Gap, Uniform Field Spark Gaps, Rod Gaps, Electrostatic Voltmeter, Generating voltmeter, The Chubb- fortescue Method, Impulse voltage Measurements using voltage dividers, Measurement of High D.C.and Impulse currents.

Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**

High Voltage Testing of Electrical Equipment: Testing of overhead line Insulators, Testing of cables, Testing of Bushings, Testing of power capacitors, Testing of circuit Breakers, Test voltage.

Unit–IV	No. of Lectures: 09 Hours	Marks: 12

EHV Testing and laboratory Equipment : Standard specification ,standard wave shapes for Testing, Impulse Generators with Inductance, Generation of switching Surges for Transformer Testing, Impulse Voltage Generators: practical circuits, Energy of Impulse Generators, Generation of Impulse currents, Generation of High Alternating Test Voltage, Generation of High Direct Voltages, General Layout of EHV laboratories.

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Emerging Technologies in Measurement : Smart sensors and Internet of Things (IoT) applications, Microelectro mechanical systems (MEMS) based sensors, Fiber optic sensors, and Nano technology based measurement techniques, Data acquisition systems .
Measuring Instruments : Digital storage oscilloscope, spectrum analyser, Transducers

Text Books:

1. Y.G.Paithankar, S.R.Bhide. “Fundamentals of Power System Protection”, PHI Learning Private Limited ,Second Edition,2010
2. Rakosh Das Begamudre, “ExtraHigh Voltage A.C. Transmission Engineering”, New Age International (p) limited , Second Edition,2010.
3. A. K. Sawhney, “A Course in Electrical and Electronic Measurements & Instrumentation”, Dhanpat Rai & Co.

Reference Books:

1. Y.G.Paithankar, S.R.Bhide. “Fundamentals of Power System Protection”, PHI Learning Private Limited ,Second Edition,2010
2. C.L.Wadhwa, “HIGH VOLTAGE ENGINEERING ”,New Age International (p) limited , Third Edition,2010.
3. Rakosh Das Begamudre, “ExtraHigh Voltage A.C. Transmission Engineering”, New Age International (p) limited , Second Edition,2010.
4. A. K. Sawhney, “A Course in Electrical and Electronic Measurements & Instrumentation”, Dhanpat Rai & Co.
5. Arun K. Ghosh, “Introduction to Measurements and Instrumentation”, PHI Publication H.S.Kalsi, “Electronic Instrumentation”, Tata McGraw Hill Private Limited, Third Edition.

NPTEL Links:

1. Measurement of High Voltage by Prof. Ravindra Arora,IIT Kanpur
   https://archive.nptel.ac.in/courses/108/104/108104048/
2. High Voltage Testing by by Prof Subba Reddy B, ISc Bangalore
   https://archive.nptel.ac.in/courses/108/108/108108099/
3. Introduction of industry 4.0 and IIOT by Prof. Sudip Misra, IIT Kharagpur
   https://archive.nptel.ac.in/courses/106/105/106105195/

HIGH VOLTAGE MEASUREMENT AND INSTRUMENTS LAB (Honors) (PCC)					
LAB COURSE CONTENT					
HIGH VOLTAGE MEASUREMENT AND INSTRUMENTS LAB		**Semester:**	**III**	**Course Code:**	**EE415A**
Teaching Scheme:		**Examination scheme**			
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: OR**			**25 marks**
		Internal Continuous Assessment (ICA) CA:			**25 marks**
End Semester Exam (ESE) Pattern:		**(Oral) OR**			

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Study of high voltage Current and Potential transformer.
2. Measurement of current using current transformer.
3. Measurement of energy using current transformer.
4. Measurement ratio and phase angle error in current transformer.
5. Measurement ratio and phase angle error in potential transformer.
6. Megger test of electrical power and control cable.
7. Use of spark gap for high voltage testing for air.
8. Study of impulse generator.
9. Flash over test of line insulator.
10. Corona discharge test.
11. Study and Layout of high voltage testing lab and earthing system

Text Books:

1. Y.G.Paithankar, S.R.Bhide. “Fundamentals of Power System Protection”, PHI Learning Private Limited ,Second Edition,2010
2. C.L.Wadhwa, “HIGH VOLTAGE ENGINEERING ”,New Age International (p) limited , Third Edition,2010.
3. Rakosh Das Begamudre, “ExtraHigh Voltage A.C. Transmission Engineering”, New Age International (p) limited , Second Edition,2010.

Reference Books:

1. Y.G.Paithankar, S.R.Bhide. “Fundamentals of Power System Protection”, PHI Learning Private Limited ,Second Edition,2010
2. C.L.Wadhwa, “HIGH VOLTAGE ENGINEERING ”,New Age International (p) limited , Third Edition,2010.
3. Rakosh Das Begamudre, “ExtraHigh Voltage A.C. Transmission Engineering”, New Age International (p) limited , Second Edition,2010.
4. A. K. Sawhney, “A Course in Electrical and Electronic Measurements & Instrumentation”, Dhanpat Rai & Co.

Text Books:

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark of each assignment on completion date declared for each assignment.

Guidelines for ESE

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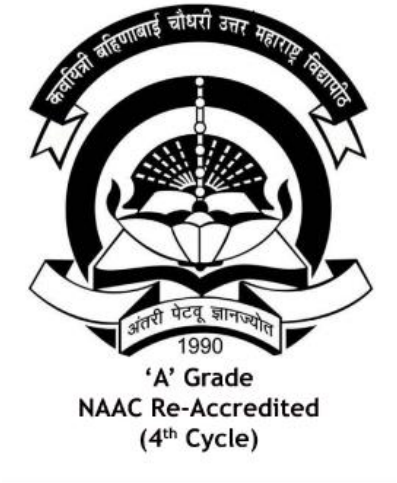
Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON

(M.S.)

Bachelor of Engineering – Honors
in
Microgrid Technologies
for Second Year Bachelor of Engineering
in
Electrical
(As per NEP 2020 Guidelines)

Faculty of Science and Technology



SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Honors in Microgrid Technologies

Syllabus Structure for Honors in Microgrid Technologies: Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -311B	Distributed Power Generation	PCC	3			3	40	60			100	3
EE -312B	Distributed Power Generation Lab	PCC			2	2			25	25 (OR)	50	1

Syllabus Structure for Honors in Microgrid Technologies: Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -414B	Energy Storage and Battery Management	PCC	3			3	40	60			100	3
EE -415B	Energy Storage and Battery Management Lab	PCC			2	2			25	25 (OR)	50	1

DISTRIBUTED POWER GENERATION (Honors) (PCC)			
COURSE OUT LINE			
Course Title:	**DISTRIBUTED POWER GENERATION**	**Short Title: DPG**	**Course Code:EE311B**

Course description:

The syllabus for Distributed Power Generation typically covers the fundamental concepts, technologies, and applications related to the generation of electrical power at or near the point of use, rather than at centralized power plants. It focuses on the integration of renewable energy sources, small-scale power generation systems, and their role in enhancing grid stability and reliability

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronics Engineering

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Explore the role of renewable energy sources such as solar, wind, hydro, and biomass in distributed generation.
2. Examine the methods for integrating distributed generation systems with the main power grid.
3. Study the importance of energy storage technologies (e.g., batteries, pumped hydro) in enhancing the effectiveness of distributed generation systems.
4. Examine real-world applications and case studies where distributed power generation has been successfully implemented.
5. Discuss emerging trends and the future of DPG in a global context.

Course outcomes:

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

1. Understand the principles and technologies behind distributed generation (DG) systems in view of environmental benefits of reducing carbon emissions.
2. Discuss emerging trends and the future of DPG in a global context.
3. Analyze distributed generation (DG) in modern power systems, including grid integration and its impact on energy reliability, security, and sustainability.
4. Examine how storage systems mitigate the intermittency of renewable power sources.
5. Solve complex problems related to distributed generation, considering technical, economic, environmental, and regulatory factors.

COURSE CONTENT

DISTRIBUTED POWER GENERATION		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Distributed Power Generation: Concept and advantages of distributed power generation, distributed power generation system energy sources, function of power electronics interface, Solar energy for distributed power generation, Wind energy for distributed power generation, fuel cells for distributed power generation, anti- islanding protection.

Unit–II	No. of Lectures: 09 Hours	Marks: 12
Solar Photovoltaic : Introduction to solar photovoltaic system, merit and limitations, economic considerations of solar PV system, principle and characteristic of solar cell, efficiency of solar cell , configuration of solar PV panel, solar PV cell technologies and small solar PV system for residence and rural areas.		
Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**
Wind Energy: Introduction to wind energy, nature of wind energy conversion system, wind power density, forces on the blades of a propeller, wind turbine efficiency, wind velocity duration characteristic , type of wind turbine-generator unit , planning of wind farm and grid connection.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Biomass Energy : Introduction to biomass energy resources, biomass conversion process, direct combustion of biomass, gaseous fuels from biomass, Introduction to urban solid waste –to-energy by incineration process, waste –to- energy incineration process and energy plant, location of plants, wood and wood waste as primary energy source		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Energy Storage and captive Power Generation: Micro Hydro plant, pump storage hydro plant, Battery energy storage system, Battery energy storage for hybrid DG system, Captive power generation, government policies for captive power generation, energy banking,		

Text Books:

1. Dr. B R Gupta, “Generation of Electrical Energy”, S Chand Publication
2. S Rao & Dr. B B Parulekar, “ Energy Technology”, Khanna Publishers.
3. Dr. H S Mukunda, Understanding Clean Energy and fuels from Biomass”, Wiley India

Reference Books:

1. Thomas Ackermann, Editor, “Wind Power in Power Systems”, John Willy and sons ltd., 2005,ISBN 0- 470-85508-8.
2. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, John Willy and sons,2004,ISBN0-471-28060-7.
3. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996,
4. ChetanSingh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI- second edition, 2011.

NPTEL Links:

1. Distributed Power Generation By Pro. N P Pandhy, IITR
   https://archive.nptel.ac.in/courses/108/107/108107113/
2. Solar and Wind Power Generation by Prof. L. Umanand, IIScB
   https://archive.nptel.ac.in/courses/108/108/108108078/
3. Renewable energy and Energy storage by Prof. Avik Bhattacharya, IITR
   https://archive.nptel.ac.in/courses/108/107/108107143/

<table>
<tr><th colspan="5">DISTRIBUTED POWER GENERATION LAB (Honors) (PCC)</th></tr>
<tr><th colspan="5">LAB COURSE CONTENT</th></tr>
<tr><td colspan="2">DISTRIBUTED POWER GENERATION LAB</td><td>Semester:</td><td>III</td><td>Course Code: EE312B</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="3">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="2">End Semester Exam (ESE) UA: OR</td><td>25 marks</td></tr>
<tr><td></td><td></td><td colspan="2">Internal Continuous Assessment (ICA) CA:</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="3">(Oral) OR</td></tr>
<tr><td colspan="5">Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.
1. Plot I-V and P-V characteristics of single Solar PV Module with radiation and temperature changing effects
2. Study effect of shading on output power of Solar PV Module
3. Study of Hotspot on Solar PV Module using thermal Camera.
4. Measure output power of solar PV system with effect of tilt angle
5. Plot charging and discharging characteristics of battery.
6. Measure performance parameters of AC load system with and without battery in Solar stand-alone PV system.
7. Study of biomass plant .
8. Study solar resource assessment station and record associated parameters
9. Simulate characteristics of fuel cell using electrical software
10. Simulate operation of wind turbine and measure associated parameters using electrical software
11. Visit of On-Grid Solar PV Power Plant.
12. Visit of Wind Power Plant.</td></tr>
<tr><td colspan="5">Text Books</td></tr>
<tr><td colspan="5">1. Dr. B R Gupta, “Generation of Electrical Energy”, S Chand Publication
2. S Rao & Dr. B B Parulekar, “ Energy Technology”, Khanna Publishers.
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3. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN 0-07-462453-9.
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<tr><td colspan="5">Guidelines for ESE</td></tr>
<tr><td colspan="5">ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral</td></tr>
</table>

ENERGY STORAGE AND BATTERY MANAGEMENT (Honors) (PCC)			
COURSE OUT LINE			
Course Title:	**ENERGY STORAGE AND BATTERY MANAGEMENT**	**Short Title: ESBM**	**Course Code:EE414B**

Course description:

The course aims to identify suitable energy storage systems for Micro grid, compare different energy storage systems and explain use of Energy management systems for Energy Storage systems.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronics Engineering

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand different types of Storage Systems for microgrid and smart grid.
2. Understand the different battery technology.
3. Identify suitable battery for energy storage purpose based on its performance and safety.
4. Understand battery charging requirements
5. Understand battery management system.

Course outcomes:

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

1. Understand different types of Storage Systems for microgrid.
2. Analysis the different battery technology based on charging and discharging characteristic.
3. Identify suitable battery for energy storage purpose based on its performance and safety.
4. Understand battery charging requirements
5. Apply best practices for battery and energy management systems .

COURSE CONTENT

ENERGY STORAGE AND BATTERY MANAGEMENT		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Battery: Introduction to Electrochemical battery, battery capacity, Battery Parameters and Comparisons, Battery Pack Discharge Curves and Aging, Battery Models, SOC, SOD, SOH, DOD, Battery technologies used in, Lead acid battery, Nickel based battery, Lithium battery, Grephene battery and comparison of Battery types.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Fuel Cells: Overview of key Fuel cell technologies, fuel cell types, electrode materials, electrolytes and other components, working principles, Hydrogen generation and storage, limitations, recent progress in Fuel cell technologies, safety issues vs cost aspects, life cycle analysis.

Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**

Ultra-capacitors: Features, basic working principle, fundamentals of Electrochemical

supercapacitors, Electrodes, and electrolyte interfaces and capacitances, charge discharge characteristics, Energy/power density, Design, fabrication, Ultracapacitor technologies, graphene based Ultracapacitors, Introduction to Flywheel, Hybridization of different energy storage devices

Unit–IV	No. of Lectures: 09 Hours	Marks: 12

Battery Charging: Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charger Functions, Real Power, Apparent Power, and Power Factor, Charging Standards and Technologies, Wireless Charging, Boost Converter for Power Factor Correction: The Boost PFC Power Stage, Sizing the Boost Inductor, Average Currents in the Rectifier, Switch and Diode Average Currents, Switch, Diode, and Capacitor RMS Currents, Power Semiconductors for Charging, Examples.

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Battery and Energy Management Systems: Battery Management Systems: Background of Battery Management Systems, Typical Structure of BMSs, Key Points of BMSs in Future Generation. Energy management strategies, Optimization techniques used in Hybrid and Electric vehicles for Energy storages, classification of Energy Management strategies, comparison and implementation issues of Energy management strategies.

Text Books:

1. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, JohnWillyandsons,2004,ISBN0-471-28060-7.
2. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN0-07-462453-9
3. S. Chowdhury, S. P. Chowdhury, PCrossley “Microgrids and Active Distribution Networks”, IET Power Electronics Series, 2012.

Reference Books:

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5. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Hussain, CRCPress ,2003.
6. Fuel Cells and Hydrogens: From Fundamentals to Applied Research by V. Hacker, S. Mitsushima, Elsevier ,2018.

NPTEL Links:

1. Energy storage by Prof. S. Banerjee, IIT Karakpur
   https://archive.nptel.ac.in/courses/108/105/108105058/
2. Battery by Prof. Ashok Jhunjhunwala, IIT Madras
   https://archive.nptel.ac.in/courses/108/106/108106182/

ENERGY STORAGE AND BATTERY MANAGEMENT LAB (Honors) (PCC)				
LAB COURSE CONTENT				
ENERGY STORAGE AND BATTERY MANAGEMENT LAB		**Semester:**	**IV**	**Course Code: EE415B**
Teaching Scheme:		**Examination scheme**		
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: OR**		**25 marks**
		Internal Continuous Assessment (ICA) CA:		**25 marks**
End Semester Exam (ESE) Pattern:		**(Oral) OR**		

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Plot charging and discharging characteristics of battery
2. Study of characteristics for Li Ion Battery
3. Study of characteristics for Fuel cell
4. Study of characteristics for Ultracapacitor
5. Visit to Electric Vehicle Battery charging station
6. Study of Battery charging circuit.
7. Study of characteristics Hybrid Energy Storage
8. To study battery management system and record associated parameters.
9. To study Tribrid system

Text Books:

1. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, JohnWillyandsons,2004,ISBN0-471-28060-7.
2. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN0-07-462453-9
3.

Reference Books:

1. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, JohnWillyandsons,2004,ISBN0-471-28060-7.
2. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN0-07-462453-9
3. Chetan Singh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI second edition
4. S. Chowdhury, S. P. Chowdhury, PCrossley “Microgrids and Active Distribution Networks”, IET Power Electronics Series, 2012.
5. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Hussain, CRCPress ,2003.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in Charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE

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Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON

(M.S.)

Bachelor of Engineering – Honors
in
Electrical Energy Systems
for Second Year Bachelor of Engineering
in
Electrical
(As per NEP 2020 Guidelines)

Faculty of Science and Technology



SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Honors in Electrical Energy Systems

Syllabus Structure for Honors in Electrical Energy Systems: Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -311C	Energy Conversion and Storage Technology	PCC	3			3	40	60			100	3
EE -312C	Energy Conversion and Storage Technology Lab	PCC			2	2			25	25 (OR)	50	1

Syllabus Structure for Honors in Electrical Energy Systems: Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -414C	Wind and Solar Energy Technology	PCC	3			3	40	60			100	3
EE -415C	Wind and Solar Energy Technology Lab	PCC			2	2			25	25 (OR)	50	1

ENERGY CONVERSION AND STORAGE TECHNOLOGY (Honors) (PCC)					
COURSE OUTLINE					
Course Title:	**ENERGY CONVERSION AND STORAGE TECHNOLOGY**	**Short Title:**	ECST	**Course Code:**	**EE311 C**

Course description:
In this curriculum, students will be explored in Energy Conversion Technologies and Energy Storage Systems. They will be introduced to concepts of fuel cells and Ultra-capacitors and Battery Charging

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Renewable Energy Technology, Power Electronics

Course objectives:

The objective of this course is to:

1. Various Conversion Technologies and its applications
2. Different types of Storage Systems
3. Dynamic Energy Conversion Technologies
4. Static Energy Conversion Technologies
5. Basic Requirements for Charging System

Course outcomes:

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

1. Identify Various Conversion Technologies
2. Identify suitable energy storage systems for Electric Vehicles.
3. Compare different energy storage systems.
4. Explain use of Energy management systems for Energy Storage systems.
5. Identify Basic Requirements for Charging System

COURSE CONTENT

ENERGY CONVERSION AND STORAGE TECHNOLOGY		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) :UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Dynamic Energy Conversion Technologies: Introduction, types of conventional and nonconventional dynamic generation technologies, principle of operation and analysis of hydro and wind based generation technologies, types of wind turbines, power in the wind, Betz limit, Tip speed ratio, stall and pitch control, wind speed statistics, probability distribution, wind generator topologies, voltage and reactive power control, power quality standard for wind turbines

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Static Energy Conversion Technologies: Principle of operation and analysis of fuel cell, photovoltaic systems and generation technologies; MPPT techniques and its classifications, principle of operation and partial shading effects; Storage Technologies -batteries, flywheels, ultra & super capacitors . Design of stand-alone systems, Amorphous mono-crystalline, poly-crystalline & Thin film solar cell, Introduction to organic Solar PV Cell

Unit–III	No. of Lectures: 09 Hours	Marks: 12

Fuel Cells: Overview of key Fuel cell technologies, fuel cell types, electrode materials, electrolytes and other components, working principles, Hydrogen generation and storage, limitations, recent progress in Fuel cell technologies, safety issues vs cost aspects, life cycle analysis.

Unit–IV	No. of Lectures: 09 Hours	Marks: 12

Ultra-capacitors: Features, basic working principle, fundamentals of Electrochemical supercapacitors, Electrodes, and electrolyte interfaces and capacitances, charge discharge characteristics, Energy/power density, Design, fabrication, Ultracapacitor technologies, graphene based Ultracapacitors, Introduction to Flywheel, Hybridization of different energy storage devices.

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Battery Charging: Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charger Functions, Real Power, Apparent Power, and Power Factor, Charging Standards and Technologies, Wireless Charging, Boost Converter for Power Factor Correction: The Boost PFC Power Stage, Sizing the Boost Inductor, Average Currents in the Rectifier, Switch and Diode Average Currents, Switch, Diode, and Capacitor RMS Currents, Power Semiconductors for Charging, Examples.

Text Books:

1. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN0-07-462453-9
2. Chetan Singh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI second edition
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Reference Books:

1. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, JohnWillyandsons,2004,ISBN0-471-28060-7.
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   https://archive.nptel.ac.in/courses/108/105/108105058/
2. Battery by Prof. Ashok Jhunjhunwala, IIT Madras
   https://archive.nptel.ac.in/courses/108/106/108106182/

ENERGY CONVERSION AND STORAGE TECHNOLOGY LAB (Honors) (PCC)				
LAB COURSE CONTENT				
ENERGY CONVERSION AND STORAGE TECHNOLOGY LAB		**Semester:**	**III**	**Course Code: EE312C**
Teaching Scheme:		**Examination scheme**		
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: OR**		**25 marks**
		Internal Continuous Assessment (ICA) CA:		**25 marks**
End Semester Exam (ESE) Pattern:		**(Oral) OR**		

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Plot charging and discharging characteristics of battery
2. Study of characteristics for Li Ion Battery
3. Study of characteristics for Fuel cell
4. Study of characteristics for Ultracapacitor
5. Visit to Electric Vehicle Battery charging station
6. Study of Battery charging circuit.
7. Study of characteristics Hybrid Energy Storage
8. To study battery management system and record associated parameters.
9. To study Tribrid system

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1. S. P. Sukhatme, “Solar Energy”, Tata McGrew Hill, second edition, 1996, ISBN0-07-462453-9
2. Chetan Singh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI second edition
3. S. Chowdhury, S. P. Chowdhury, PCrossley “Microgrids and Active Distribution Networks”, IET Power Electronics Series, 2012.

Reference Books:

1. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, JohnWillyandsons,2004,ISBN0-471-28060-7.
2. S. Chowdhury, S. P. Chowdhury, PCrossley “Microgrids and Active Distribution Networks”, IET Power Electronics Series, 2012.
3. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Hussain, CRCPress ,2003.
4. Fuel Cells and Hydrogens: From Fundamentals to Applied Research by V. Hacker, S. Mitsushima, Elsevier ,2018.

Guidelines for ICA:

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Guidelines for ESE

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral

WIND AND SOLAR ENERGY TECHNOLOGY (Honors) (PCC)			
COURSE OUT LINE			
Course Title:	**WIND AND SOLAR ENERGY TECHNOLOGY**	**Short Title: WST**	**Course Code:EE414C**

Course description:

In this curriculum, students will be explored in Renewable Energy Technologies such as Wind energy, Solar energy. They will be introduced to concepts of fuel cells and biomass energy.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronics Engineering

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand different types of energy sources
2. Various solar PV technologies and its characteristics
3. Various solar thermal technologies and its applications
4. Wind energy technologies and its operations
5. Grid integration of wind energy systems and its associated issues

Course outcomes:

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

1. Elaborate different types of energy sources
2. Explain various solar PV technologies and its characteristics and solve numerical on it
3. Describe various solar thermal technologies and its uses in various applications
4. Discuss wind energy technologies and explain its operations
5. Explain grid integration of wind energy systems and its associated issues

COURSE CONTENT

WIND AND SOLAR ENERGY TECHNOLOGY		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Basics of Energy: Energy and Power, Hubert peak, Energy Scenario in India, Environmental impact of fossil fuels, Different types of energy sources - solar, wind, tidal, geothermal, wave energy, Introduction to fuel cells and Biomass

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Solar PV Technology: Amorphous mono-crystalline, poly-crystalline, V-I characteristics, Shading impact, PV module, Array, Maximum Power Point Tracking, Grid connected and standalone systems

Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**

Solar Thermal Technology: Solar Spectrum, Solar Geometry, Sun Earth angles, Solar radiation at given locations, Flat plate collector, Parabolic trough, Central receiver, parabolic dish, Fresnel, solar pond, solar still

Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**

Wind Energy Technology: History of wind power, types of wind turbines, power in the wind,

Betz limit, Tip speed ratio, stall and pitch control, wind speed statistics, probability distribution, wind generator topologies, voltage and reactive power control, power quality standard for wind turbines

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Grid Integration of Wind Energy: Wind farms, real and reactive power regulation, voltage and frequency operating limits, wind farm behavior during grid disturbances, power system interconnection, Economic aspects

Text Books:

1. Thomas Ackermann, Editor, "Wind Power in Power Systems", John Willy and sons ltd., 2005,ISBN 0- 470-85508-8
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", John Willy and sons,2004,ISBN0-471-28060-7.

Reference Books:

1. S. P. Sukhatme, "Solar Energy", Tata McGrew Hill, second edition, 1996, ISBN 0-07-462453-9.
2. ChetanSingh Solanki, "Solar Photovoltaics", fundamental, technologies and applications, PHI- second edition, 2011
3. Siegfried Heier, "Grid integration of wind energy conversion systems" John Willy and sons ltd.2006.
4. Mullic and G.N.Tiwari, "Renewable Energy Applications", Pearson Publications.
5. John A. Duffie, William A. Beckman, "Solar Engineering of Thermal Processes", Wiley Inter science Publication, 1991

NPTEL Links:

1. Distributed Power Generation By Pro. N P Pandhy, IITR
   https://archive.nptel.ac.in/courses/108/107/108107113/
2. Solar and Wind Power Generation by Prof. L. Umanand, IIScB
   https://archive.nptel.ac.in/courses/108/108/108108078/
3. Renewable energy and Energy storage by Prof. Avik Bhattacharya, IITR
   https://archive.nptel.ac.in/courses/108/107/108107143/

<table>
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<tr><td colspan="2">Teaching Scheme:</td><td colspan="4">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="3">End Semester Exam (ESE) UA: OR</td><td>25 marks</td></tr>
<tr><td></td><td></td><td colspan="3">Internal Continuous Assessment (ICA) CA:</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="4">(Oral) OR</td></tr>
<tr><td colspan="6">Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.
1. Plot I-V and P-V characteristics of single Solar PV Module with radiation and temperature changing effects
2. Study effect of shading on output power of Solar PV Module
3. Measure output power of solar PV system with effect of tilt angle
4. Plot charging and discharging characteristics of battery.
5. Measure performance parameters of AC load system with and without battery in Solar stand-alone PV system.
6. Study of biomass plant .
7. Study solar resource assessment station and record associated parameters
8. Simulate characteristics of fuel cell using electrical software
9. Simulate operation of wind turbine and measure associated parameters using electrical software
10. Visit of On-Grid Solar PV Power Plant.
11. Visit of Wind Power Plant.</td></tr>
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<tr><td colspan="6">1. Thomas Ackermann, Editor, “Wind Power in Power Systems”, John Willy and sons ltd., 2005,ISBN 0- 470-85508-8
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Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON

(M.S.)

Bachelor of Engineering – Minor
in
Electrical and Power Engineering
for Second Year Bachelor of Engineering
offered by
Electrical

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



SYLLABUS STRUCTURE & COURSE OUTLINE

For Affiliated Colleges

Semester – III & IV

W.E.F. 2025 – 26

Specialization Minor in Electrical and Power Engineering

Syllabus Structure for Specialization Minor in Electrical and Power Engineering: Additional Credit (Semester – III) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -313A	Electrical Machines and Transformer	PCC	3			3	40	60			100	3
EE -314A	Electrical Machines and Transformer Lab	PCC			2	2			25	25 (OR)	50	1

Syllabus Structure for Specialization Minor in Electrical and Power Engineering: Additional Credit (Semester – IV) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -416A	Power System Engineering	PCC	3			3	40	60			100	3
EE -417A	Power System Engineering Lab	PCC			2	2			25	25 (OR)	50	1

ELECTRICAL MACHINES AND TRANSFORMER (Minor) (PCC)			
COURSE OUT LINE			
Course Title:	**ELECTRICAL MACHINES AND TRANSFORMER**	**Short Title: EMT**	**Course Code:EE313A**

Course description:

This course provides knowledge about D. C. machines and transformers to familiarize students with construction, working, operation, performance and applications of DC machines and Transformer.

	Hours/week	No.of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understanding on basic principles, construction, and operation of machine and transformer.
2. Identify the classification of machines depend upon construction and working operation
3. Evaluate the performance characteristics and application of Special Purpose Machine.
4. Correlate the characteristic of different machines and transformer for different application.
5. Evaluate the performance of machines and transformer

Course outcomes:

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

1. Understand fundamental principles of operation and construction for machines and transformer.
2. Solve engineering problems of machines and transformers.
3. Identify type of special purpose machine.
4. Analyze test data for qualitative and quantitative of machines and transformer to determine characteristics.
5. Identify the application of machines and transformers based on their characteristic.

COURSECONTENT

ELECTRICAL MACHINES AND TRANSFORMER		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40 marks**

Unit–I	**No.of Lectures: 09 Hours**	**Marks: 12**

DC Machines: Construction of dc machine, Induced emf in an armature coil, method of excitation and classification of dc generators, voltage build-up in a shunt generator, Voltage regulation,
DC motor principle and working, back emf, classification of dc motors, torque equation, speed-armature current characteristic of motors, speed control, losses and efficiency.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

AC Motor : Construction and working operation of three phase induction motor, classification, concept of slip, development of torque, torque-slip characteristic, concept of power stage and losses, speed control and starters.
Classification of single phase induction motor and applications.

Unit–III	No. of Lectures: 09 Hours	Marks: 12
Synchronous Machine: Construction and operation of three phase synchronous alternator (Machine), armature winding, winding factor, emf equation, excitation system, voltage drops in alternator, concept of synchronous impedance, calculation voltage regulation by synchronous impedance method. Working operation of synchronous motor, Main features of synchronous motor, application of synchronous motor.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Special Purpose Machine: Construction, basic working principle and application of Universal motor, Permanent Magnet DC Motor, BLDC Motor, Stepper Motor and Servo motor.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Transformer : Construction and Principle of operation of single-phase transformers, Core and Shell type transformer, EMF equation of transformer, losses and efficiency, Three-phase Transformer: construction, types of connection and their comparative features, Tap-changer on transformers, transformer tank and cooling.		

Text Books:

1. Ashfaq Husain, “Electrical Machines”, DhanpatRai& Co.
2. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
3. B. L. Tharaja, “Course in Electrical Technology, Volume-II,” S Chand Publication.

Reference Books:

6. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
7. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
8. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
9. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.

NPTEL Links:

6. DC Machines by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
7. DC Machines by Prof. D Kastha,IITK
   https://archive.nptel.ac.in/courses/108/105/108105017/
8. Armature reaction by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
9. Speed Control of DC Machine by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
10. Transformer by Prof. G.Bhuvaneshwari, IITD
    https://archive.nptel.ac.in/courses/108/102/108102146/

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<tr><td colspan="2">ELECTRICAL MACHINES AND TRANSFORMER LAB</td><td colspan="2">Semester: III</td><td colspan="2">Course Code: EE314A</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="4">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="3">End Semester Exam (ESE) UA: OR</td><td>25 marks</td></tr>
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<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="4">(Oral) OR</td></tr>
<tr><td colspan="6">Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.
1. Determination of voltage regulation of d.c generator.
2. Speed control of D.C shunt motor by armature and field control.
3. Study of DC motors starters and Direction Reversal of D. C. Shunt motor.
4. Determination of performance characteristic of DC series motor by direct load test.
5. Determination of voltage regulation of three phase alternator.
6. Determination of characteristic of Synchronous motor at constant load variable excitation.
7. Load test on three phase induction motor.
8. Study of three phase induction motor starters
9. Ratio test on single phase transformer
10. Determination of performance of single phase transformer by direct load test.
11. Study of cooling methods in 3 phase distribution transformer.</td></tr>
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<tr><td colspan="6">1. S.G Tarnekar ,P K Kharbanda, “A Text Book on Laboratory Course in Electrical Engineering,” S Chand Publication.
2. B. L. Tharaja, “Course in Electrical Technology, Volume-II,” S Chand Publication.</td></tr>
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<tr><td colspan="6">4. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
5. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
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<tr><td colspan="6">Guidelines for ESE</td></tr>
<tr><td colspan="6">ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral</td></tr>
</table>

POWER SYSTEM ENGINEERING (Minor) (PCC)			
COURSE OUT LINE			
CourseTitle:	**POWER SYSTEM ENGINEERING**	**Short Title: PSE**	**Course Code: EE416A**

Course description:

This course provides knowledge about Power System Engineering to familiarize students with generation of Electric Power by various conventional and Non-conventional sources, The students also familiarize about the economics of the power system, tariff and Interconnected system.

	Hours/week	No.of weeks	Total hours	Semester credits
Theory	03	15	45	03
Practical	02	15	30	01

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Impart knowledge of generation of Electrical power by various sources.
2. Enable students to learn economic of the Power system.
3. Enable students to learn about the tariff and power factor improvement.
4. Analyze and determine the parallel operation of the power plant.
5. Impart knowledge of interconnected system.

Course outcomes:

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

1. Demonstrate the working of various conventional power plants.
2. Understand the economics of the power system.
3. Illustrate constructional and other aspect related to Non-conventional Energy Sources.
4. Identification of technical and economic advantage of power factor improvement along tariff calculation.
5. Understand the importance of interconnected systems and its Applications.

COURSE CONTENT

POWER SYSTEM ENGINEERING		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40 marks**

Unit–I:	**No.of Lectures: 09 Hours**	**Marks: 12**

Generation of Electrical Power (Conventional Sources): Introduction: Typical Layout of an Electrical Power System, Present Power Scenario in India. Generation of Electric Power: Conventional Sources, basic requirements, site selection, principle of working, main components (block diagram), and auxiliary components of Hydro Electric power plant, Thermal Electric power plant and Nuclear Electric power plant.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Generation of Electrical Power (Non-Conventional Sources): Solar photovoltaic system, principle and characteristics of solar cell, efficiency of solar cell, configuration of solar PV panel, solar PV cell technologies and small solar PV system for residential and rural areas.
Wind Energy: Nature of wind energy conversion system, wind power density, wind turbine efficiency, wind velocity duration characteristics. Wind turbine generator unit.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Economics of the Power System: Introduction, Energy requirement, Maximum demand, Variation in demand, Chronological load curve, Load duration curve Energy Load curve, Mass

curve, load factor, Capacity factor, Utilization factor, Base load and peak load plants.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Tariffs and Power factor improvement: Introduction, Objectives of Tariff, Electric Utility versus other forms of business, General Tariff plant, Spot Pricing, Apparent Energy Tariff, Power factor management, technical and economic advantage of power factor improvement Graphical calculation of kVAR requirement, Location of Shunt capacitor

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Interconnected Systems: Introduction, Types of Interconnection, Advantages of Interconnection, Reactive Power requirement during peak and off peak hours, Role of Information Technology in Energy management

Parallel operation of Power plant: Introduction, Synchronizing Current, Power, Infinite bus bar, Synchronizing Power.

Text Books:

1. B.R.Gupta, “Generation of Electrical Energy”, S Chand Publication.
1. Chakraborti, Soni, Gupta & Bhatnagar, “Power System Engineering”, Dhanpat Rai & Co. limited.

Reference Books:

2. W. D. Stevenson, “Elements of Power System Analysis”, Mc Graw Hill, 4th edition.
3. C.L. Wadhwa, “Electrical Power System”, New Age International limited.
4. HadiSaadat, “Power System Analysis”, Tata McGraw Hill 2nd edition.
5. L. P. Singh; “Advanced Power System Analysis & Dynamics”, New Age International
6. Chakraborthy, Soni, Gupta & Bhatnagar, “Power System Engineering”, Dhanpat Rai & Co. limited.
7. T.K Nagsarkar, M.S. Sukhija, “Power System Analysis” Oxford University Press.
8. S. Sivanagaraju, G. Sreenivasan, “Power System Operation and Control”, Pearson.

NPTEL Links:

1. Power System Engineering by prof. Debapriya Das, IIT Kharagpur
   https://archive.nptel.ac.in/courses/108/105/108105104/
2. Power Electronics and Distributed Generation by Prof. Vinod John IIS Banglore
   https://archive.nptel.ac.in/courses/108/108/108108034/
3. Restructured Power System by Prof S.A. Khaparde and Dr. A.R. Abhyankar IIT delhi
   https://archive.nptel.ac.in/courses/108/101/108101005/
4. Power System Operation and Control by Prof. A.M.Kulkarni IIT Bombay
   https://archive.nptel.ac.in/courses/108/101/108101040/
5. Power System Generation, Transmission and Distribution by Prof. D.P. Kothari IIT Delhi
   https://archive.nptel.ac.in/courses/108/102/108102047/

<table>
<tr><th colspan="5">POWER SYSTEM ENGINEERING LAB (Minor) (PCC)</th></tr>
<tr><th colspan="5">LAB COURSE CONTENT</th></tr>
<tr><td colspan="2">POWER SYSTEM ENGINEERING LAB</td><td>Semester:</td><td>IV</td><td>Course Code: EE417A</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="3">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="2">End Semester Exam (ESE) UA: OR</td><td>25 marks</td></tr>
<tr><td></td><td></td><td colspan="2">Internal Continuous Assessment (ICA) CA:</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="3">(Oral) OR</td></tr>
<tr><td colspan="5">Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.
1. Study and layout of Thermal Power Plant.
2. Study and layout of Hydro Power Plant.
3. Study and layout of Nuclear Power Plant.
4. Study and layout of Solar PV Power plant.
5. Effect of change of Solar PV Module angle on power generation.
6. Measurement of parameters from Solar PV inverter.
7. Study and Identification of Constant and variable component of LT Tariff.
8. Study and Identification of Constant and variable component of HT Tariff.
9. Power factor improvement of Inductive load by shunt capacitor.
10. Procedure and connection of two three phase alternator in Parallel.
11. Effect of change of excitation and mechanical input for parallel operated three phase alternator</td></tr>
<tr><td colspan="5">Text Books:</td></tr>
<tr><td colspan="5">1. B.R.Gupta, “Generation of Electrical Energy”, S Chand Publication.
2. Chakraborti, Soni, Gupta “ A Power Plant System Engg”, Dhanpat Rai Publication</td></tr>
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<tr><td colspan="5">1. W. D. Stevenson, “Elements of Power System Analysis”, Mc Graw Hill, 4th edition.
2. C.L. Wadhwa, “Electrical Power System”, New Age International limited.
3. HadiSaadat, “Power System Analysis”, Tata McGraw Hill 2nd edition.
4. L. P. Singh; “Advanced Power System Analysis & Dynamics”, New Age International
5. Chakraborthy, Soni, Gupta & Bhatnagar, “Power System Engineering”, Dhanpat Rai & Co. limited.
6. T.K Nagsarkar, M.S. Sukhija, “Power System Analysis” Oxford University Press.
7. S. Sivanagaraju, G. Sreenivasan, “Power System Operation and Control”, Pearson.</td></tr>
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Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Bachelor of Engineering – Minor in Electrical Machines and Drives for Second Year Bachelor of Engineering offered by Electrical

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS STRUCTURE & COURSE OUTLINE

For Affiliated Colleges

Semester – III & IV

W.E.F. 2025 – 26

Specialization Minor in Electrical Machines and Drives

Syllabus Structure for Specialization Minor in Electrical Machines and Drives: Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -313B	AC Circuit and Measurement	PCC	3			3	40	60			100	3
EE -314B	AC Circuit and Measurement Lab	PCC			2	2			25	25 (OR)	50	1

Syllabus Structure for Specialization Minor in Electrical Machines and Drives: Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -416B	DC Machines and Transformer	PCC	3			3	40	60			100	3
EE -417B	DC Machines and Transformer Lab	PCC			2	2			25	25 (OR)	50	1

AC CIRCUIT AND MEASUREMENT (Minor) (PCC)			
COURSE OUT LINE			
CourseTitle:	**AC CIRCUIT AND MEASUREMENT**	**Short Title: ACM**	**Course Code:EE313B**

Course description:

This course provides knowledge about AC circuit and measurement to familiarize students with construction, their working, operation, performance and applications of various electrical measuring instruments and also about AC circuit.

	Hours/week	No.of weeks	Total hours	Semester credits
Theory	03	15	45	03
Practical	02	15	30	01

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. To impart knowledge of principles of measurement of electrical quantities.
2. To enable students to learn construction and operating principles of electrical instruments.
3. To enable students to learn static and dynamic characteristics of electrical instruments.
4. To analyze and minimize errors in measurement.
5. To impart knowledge of IS codes and be able to do the electrical testing.

Course outcomes:

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

1. Understand the operation of three phase AC circuit and relations between interconnection of 3 phase circuit
2. Relate the purpose, classification and errors in the Electrical Measurement.
3. Compare various bridges for measurement of Electrical parameters.
4. Determine the various methods for measurement of power in electrical circuits. Calibrate various types of instruments as per IS.
5. Analyze the energy measurement and calibration of Energy Meters.

COURSE CONTENT

AC CIRCUIT AND MEASUREMENT		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Polyphase Circuits: Generation of Polyphase Voltage, Phase sequence, Interconnection of Three phases, Phase voltage, Star or Y connection, Relation between Phase Voltage and Line Voltage in Star Connection Relation between Phase Current and Line Current in Star Connection, Delta or Mesh connection, Relation between Phase Voltage and Line Voltage in Delta Connection, Relation between Phase Current and Line Current in Delta Connection, Balanced Y/Δ and Δ / Y conversion, Unbalanced Load, Four wire star connected unbalanced load, Unbalanced Y-connected load without Neutral.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Electrical Measurement: Definition, purpose, measurement – definitions, types and Classification of instruments, Generalized measurement system, standards, and calibrations, Errors – types – gross, systematic, random, limiting, sources of errors, techniques to minimize them. Instrument transformers theory, Expression for ratio and phase angle errors.

Unit–III	No. of Lectures: 09 Hours	Marks: 12
D.C. and A .C. Bridge: DC Bridges: Wheatstone bridge, Kelvin‟s double bridge, Megger, D.C. potentiometer. AC Bridges: Classification, Maxwell, Anderson, Schering, and Wein Bridge. Introduction to PMMC and MI		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Measurement of Power: Construction and principle of operation of electrodynamic wattmeter, low P. F. wattmeters, Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter method.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Measurement of Energy: Construction and principle of operation, Torque equation for the induction type of energy-meter, Calibration of Energy meters, and three phase energy meter. Electronic Energy meters- construction and principle.		

Text Books:

1. A. K. Sawhney. “A Course in Electrical & Electronic Measurement and Instrumentation” Dhanpant Rai & Co. 19th Edition.

Reference Books:

1. E. W. Golding, “Electrical Measurements and Measuring instruments”, Reem Publication, 23rd edition.
2. C. T. Baldwin, “Fundamentals of Electrical Measurements”, Kalyani Publication, 2 nd edition.
3. Cooper and Derfllick, “Electronic Instrumentation and Measurements Techniques”, Prentice-Hall of India, 3rd edition.
4. J. B. Gupta, “Electrical & Electronic Measurement and Instrumentation”, S. K. Kataria & Son, 14th edition.
5. R. K. Rajput, “Electrical & Electronic Measurement and Instrumentation”, S. Chand.

NPTEL Links:

1. Course on Electrical Measurement and Electronic Instruments by Prof. Avishek Chatterjee, IIT Kharagpur
   https://archive.nptel.ac.in/courses/108/105/108105153/
2. Introduction to Electrical Engineering Prof. Bhim Singh, IIT Delhi
   https://archive.nptel.ac.in/courses/108/102/108102185/
3. Basic Electric Circuits by Prof. Ankush Sharma, IIT Kanpur
   https://archive.nptel.ac.in/courses/108/104/108104139/
4. Fundamentals of Electrical Engineering by Prof. Debapriya Das, IIT Kharagpur
   https://archive.nptel.ac.in/courses/108/105/108105155/
5. Basic Electrical Technology, Prof. N.K. De, Prof. G.D. Roy, prof. T.K. Bhattacharya IIT Kharagpur
   https://archive.nptel.ac.in/courses/108/105/108105053/

AC CIRCUIT AND MEASUREMENT LAB (Minor) (PCC)				
LAB COURSE CONTENT				
AC CIRCUIT AND MEASUREMENT LAB		**Semester:**	**III**	**Course Code: EE314A**
Teaching Scheme:		**Examination scheme**		
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: OR**		**25 marks**
		Internal Continuous Assessment (ICA) CA:		**25 marks**
End Semester Exam (ESE) Pattern:		**(Oral) OR**		

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Measurement of current using current transformer.
2. Measurement of active power in three phase circuit by two wattmeter method.
3. Measurement of reactive power by two wattmeter and single wattmeter.
4. Calibration of single phase energy meter at different P.F.'s
5. Calibration of three phase two elements energy meter at different P.F.'s
6. D.C. potentiometer for calibration of ammeter and voltmeter.
7. Kelvin's double bridge: Measurement of low resistance.
8. Measurements of phase angle error and ration error of current Transformer
9. Measurements of phase angle error and ration error of Potential Transformer.
10. Measurement of earth resistance.
11. Measurement of insulation resistance by Megger

Text Books

1. A. K. Sawhney. "A Course in Electrical & Electronic Measurement and Instrumentation" Dhanpant Rai & Co. 19th Edition.

ReferenceBooks:

1. E. W. Golding, "Electrical Measurements and Measuring instruments", Reem Publication, 23rd edition.
2. C. T. Baldwin, "Fundamentals of Electrical Measurements", Kalyani Publication, 2 nd edition.
3. Cooper and Derfllick, "Electronic Instrumentation and Measurements Techniques", Prentice-Hall of India, 3rd edition.
4. J. B. Gupta, "Electrical & Electronic Measurement and Instrumentation", S. K. Kataria & Son, 14th edition.
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Guidelines for ESE

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DC MACHINES AND TRANSFORMER (Minor) (PCC)			
COURSE OUT LINE			
Course Title:	**DC MACHINES AND TRANSFORMER**	**Short Title: DCMT**	**Course Code:EE416B**

Course description:

This course provides knowledge about D. C. machines and transformers to familiarize students with construction, their working, operation, performance and applications of DC machines and Transformer.

	Hours/week	No.of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understanding on basic principles, construction, and operation of machine and transformer.
2. Identify the classification of machines depend upon construction and working operation
3. Evaluate the performance characteristics and application of Special Purpose Machine.
4. Correlate the characteristic of DC machines and transformer for different application.
5. Evaluate the performance of DC machines and transformer

Course outcomes:

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

1. Understand fundamental principles of operation and construction for DC machines and transformer.
2. To solve engineering problems of dc motor, dc generator and transformer
3. Identify type of special purpose machine.
4. Analyze test data for qualitative and quantitative parameters to determine characteristics of machines and transformer.
5. Evaluate the steady state parameters, basic operating characteristics and performance of DC Machine and transformers for different application.

COURSECONTENT

DC MACHINES AND TRANSFORMER		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40marks**

Unit–I	**No.of Lectures: 09 Hours**	**Marks: 12**

DC Generator: Construction of dc machine, Induced emf in an armature coil, lap and wave winding, method of excitation and classification of dc generators, voltage build-up in a shunt generator, Commutation, characteristics of dc generators application of DC generator.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

DC Motor: DC motor principle and working, back emf, classification of dc motors, torque equation, speed-armature characteristic and speed torque characteristics of motors, armature Power stages, losses and efficiency.

Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**

Special Purpose Machine: Construction, basic working principal and application of Universal

motor, Permanent Magnet DC Motor, BLDC Motor, Stepper Motor and Servo motor.

Unit–IV	No. of Lectures: 09 Hours	Marks: 12

Single Phase Transformer: Construction and Principle of operation of single-phase transformers, Core and Shell type transformer, EMF equation of transformer, losses and efficiency, condition for maximum efficiency and voltage regulation.

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Three-phase Transformer: construction, types of connection and their comparative features, Tap-changer on transformers , All Day Efficiency of distribution transformer, Transformer tank and cooling.

Text Books:

1. Ashfaq Husain, “Electrical Machines”, DhanpatRai& Co.
2. B. L. Tharaja, “Course in Electrical Technology, Volume-II,” S Chand Publication.

Reference Books:

1. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
2. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
3. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.
4. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
5. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

NPTEL Links:

1. DC Machines by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
2. DC Machines by Prof. D Kastha,IITK
   https://archive.nptel.ac.in/courses/108/105/108105017/
3. Armature reaction by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
4. Speed Control of DC Machine by Prof. Tapas Kumar Bhattacharya, IITK
   https://archive.nptel.ac.in/courses/108/105/108105155/
5. Transformer by Prof. G.Bhuvaneshwari, IITD
   https://archive.nptel.ac.in/courses/108/102/108102146/

<table>
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<tr><th colspan="6">LAB COURSE CONTENT</th></tr>
<tr><td colspan="2">DC MACHINES AND TRANSFORMER LAB</td><td>Semester:</td><td>IV</td><td colspan="2">Course Code: 417B</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="4">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="3">End Semester Exam (ESE) UA: OR</td><td>25 marks</td></tr>
<tr><td></td><td></td><td colspan="3">Internal Continuous Assessment (ICA) CA:</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="4">(Oral) OR</td></tr>
<tr><td colspan="6">Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.
1. Determination of voltage regulation of d.c.generator.
2. Speed control of D.C shunt motor by armature and field control.
3. Study of DC motors starters.
4. Direction Reversal of D. C. Shunt motor.
5. Determination of performance characteristic of DC series motor by direct load.
6. Ratio test on single phase transformer
7. Determination of performance of single phase transformer by direct load test.
8. Study of three phase transformer and its major hardware component.
9. Study of cooling methods in 3 phase distribution transformer.</td></tr>
<tr><td colspan="6">Text Books</td></tr>
<tr><td colspan="6">1. S.G Tarnekar ,P K Kharbanda, “A Text Book on Laboratory Course in Electrical Engineering,” S Chand Publication.
2. B. L. Tharaja, “Course in Electrical Technology, Volume-II,” S Chand Publication.</td></tr>
<tr><td colspan="6">ReferenceBooks:</td></tr>
<tr><td colspan="6">1. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
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Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON

(M.S.)

Bachelor of Engineering – Minor
in
Electric Vehicles
for Second Year Bachelor of Engineering
offered by
Electrical

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS STRUCTURE & COURSE OUTLINE

For Affiliated Colleges

Semester – III & IV

W.E.F. 2025 – 26

Syllabus Structure for Specialization Minor in Electric Vehicles: Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -313C	Electric Vehicle Technology	PCC	3			3	40	60			100	3
EE -314C	Electric Vehicle Technology Lab	PCC			2	2			25	25 (OR)	50	1

Syllabus Structure for Specialization Minor in Electrics Vehicles: Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
EE -416C	Electric Vehicle Motors and Drives	PCC	3			3	40	60			100	3
EE -417C	Electric Vehicle Motors and Drives Lab	PCC			2	2			25	25 (OR)	50	1

ELECTRIC VEHICLE TECHNOLOGY (Minor) (PCC)					
COURSE OUTLINE					
Course Title:	**ELECTRIC VEHICLE TECHNOLOGY**	**Short Title:**	EVT	**Course Code:**	**EE313C**

Course description:
This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. The material for this course will be prepared in such a manner that it will be useful for postgraduate students, teachers, practitioners, and final year undergraduate students. This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc. Each topic will be developed in logical progression with up-to-date information.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):
Electric Machines and Drives, Power Electronics

Course objectives:
The objective of this course is to:
1. Explain the basics of electric and hybrid electric vehicles, their architecture,
2. Explain plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
3. Analyze various electric drives suitable for hybrid electric vehicles
4. Discuss different energy storage technologies used for hybrid electric vehicles .
5. Demonstrate different configurations of electric vehicles and its components, hybrid vehicle .

Course outcomes:
After successful completion of this course the student will be able to:
1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies, and fundamentals.
2. Analyze the use of different power electronics devices and electrical machines in hybrid Electric vehicles.
3. Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
4. Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration.
5. Analyze the use of different energy management strategies used in Evs

COURSE CONTENT

ELECTRIC VEHICLE TECHNOLOGY		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) :UA**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) :CA	**40 marks**

Unit–I	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Electric Vehicle: History of Electric Vehicles ,History of Hybrid Electric Vehicles,
Electric Vehicle: Pure Electric Vehicle, Hybrid Electric Vehicle, Gridable Hybrid Electric Vehicle, Fuel Cell Electric Vehicle, Electric Vehicle Technology: Motor Drive Technology,

Energy Source Technology, Battery Charging Technology, Vehicle to Grid Technology.

Unit–II	No. of Lectures: 09 Hours	Marks: 12

Architecture of EVs: Configurations of EVs , Performance of EVs , Traction Motor Characteristics , Tractive Effort and Transmission Requirement , Vehicle Performance , Effort in Normal Driving , Energy Consumption

Unit–III	No. of Lectures: 09 Hours	Marks: 12

Architecture of HEVs : Concept of Hybrid Electric Drive Trains , Architectures of Hybrid Electric Drive Trains , Series Hybrid Electric Drive Trains (Electrical Coupling) ,Parallel Hybrid Electric Drive Trains (Mechanical Coupling) Parallel Hybrid Drive Train with Torque Coupling ,Parallel Hybrid Drive Train with Speed Coupling .

Unit–IV	No. of Lectures: 09 Hours	Marks: 12

Fundamentals of Vehicle Propulsion and Brake : General Description of Vehicle Movement, Vehicle Resistance , Rolling Resistance ,Aerodynamic Drag ,Grading Resistance ,Dynamic Equation , Tire–Ground Adhesion and Maximum Tractive Effort , Power Train Tractive Effort and Vehicle Speed

Unit–V	No. of Lectures: 09 Hours	Marks: 12

Energy Storage: Electrochemical Batteries , Electrochemical Reactions, Thermodynamic Voltage , Specific Energy , Specific Power, Energy Efficiency , Battery Technologies , Lead–Acid Battery , Nickel-Based Batteries , Lithium-Based Batteries , Ultracapacitors , Features of Ultracapacitors , Basic Principles of Ultracapacitors , Ultracapacitor Technologies , Concept of Hybrid Energy Storage , Passive and Active Hybrid Energy Storage

Text Books:

1. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 1st edition, 2004.
2. C. Mi, M. A. Masrur, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, Wiley-Blackwell, 2nd edition, 2017.
3. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer; 1st edition, 2015.

Reference Books:

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2nd edition, Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon (M.S.)
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 1st edition, 2004.
3. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley, 1st edition, 2008.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 1st edition, 2016. Optics – Ajoy Ghatak, McGraw Hill Publishing

NPTEL Links:

1. Electric vehicles and Renewable energy , by Prof. Ashok Jhunjhunwala, IIT Madras https://archive.nptel.ac.in/courses/108/106/108106182/
2. Fundamentals of Electric vehicles: Technology & Economics , by Prof. Ashok Jhunjhunwala, IIT Madras, https://archive.nptel.ac.in/courses/108/106/108106170/

ELECTRIC VEHICLE TECHNOLOGY LAB (Minor) (PCC)				
LAB COURSE CONTENT				
ELECTRIC VEHICLE TECHNOLOGY LAB		**Semester:**	**III**	**Course Code: 314C**
Teaching Scheme:		**Examination scheme**		
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: OR**		**25 marks**
		Internal Continuous Assessment (ICA) CA:		**25 marks**
End Semester Exam (ESE) Pattern:		**(Oral) OR**		

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Architectures of Pure Electric Vehicle
2. Architectures of Hybrid Electric Vehicle
3. Architectures of Series Hybrid Electric Drive Trains
4. Architectures of Parallel Hybrid Electric Drive Trains
5. Study of Aerodynamic design of Electric Vehicle.
6. Study of characteristics for Li Ion Battery.
7. Study of characteristics for ultra-capacitor for EV application.
8. Study of characteristics for Hybrid Energy Storage
9. To study battery management system and record associated parameters.

Text Books:

1. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 1st edition, 2004.
2. C. Mi, M. A. Masrur, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, Wiley-Blackwell, 2nd edition, 2017.
3. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer; 1st edition, 2015.

Reference Books:

1. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2nd edition, Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon (M.S.)
2. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 1st edition, 2004.
3. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley, 1st edition, 2008.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 1st edition, 2016. Optics – Ajoy Ghatak, McGraw Hill Publishing

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty In charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral

ELECTRIC VEHICLE MOTORS AND DRIVES (Minor) (PCC)			
COURSE OUT LINE			
CourseTitle:	**ELECTRIC VEHICLE MOTORS AND DRIVES**	**Short Title: EVMD**	**Course Code: EE416C**

Course description:

The course aims to give a broad view of Electrical Vehicle Drive System. It is considered that students have prior knowledge of Electrical Machines and Power Electronics. The control principles for AC and DC motors fed converters are discussed. Principles of selection for Electric Vehicle AC DC motors Drive are also discussed.

	Hours/week	No.of weeks	Total hours	Semester credits
Theory	03	15	45	**03**
Practical	02	15	30	**01**

Prerequisite course(s):

Basic Electrical and Electronic Engineering at First Year

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand the requirement of electric vehicle motor and drives
2. Identify most of the widely used for Electric Vehicle motors Drives,
3. Understand performance of DC motors drives and its speed torque characteristics.
4. Learn about special purpose motor drives for electric vehicle.
5. Understand the control of electric vehicle drives

Course outcomes:

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

1. Selecta drive for a particular application based on power rating.
2. Selecta drive based on mechanical characteristics for a particular electric vehicle drive application.
3. Understand the different special purpose motor drives for electric vehicle.
4. Analyze operation and control of motor drives under different modes.
5. Identify suitable braking methods based on technical and economical aspect for electric vehicle.

COURSE CONTENT

ELECTRIC VEHICLE MOTOR AND DRIVES		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA**	**60marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA	**40marks**

Unit–I	**No.of Lectures: 09 Hours**	**Marks: 12**

DC Motor Drives: Requirement of electric vehicle motor, characteristic of traction motor, Important features of Traction drive, Traction motors, Traction drives, DC shunt and Series motor, concept of torque, Torque - speed characteristic of motor. DC Motor control, speed control ,Design criteria of DC motor drive for EVs

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**

Induction Motor Drives: construction and working operation, PWM inverters ,induction motor control, variable voltage variable frequency control, direct torque control, Design criteria of Induction motor drive for EVs

Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**

Special Purpose Machines: Construction and principle of operation of Permanent magnet DC

motors, Brushless DC motors, Permanent Magnet Synchronous Motors, preferred technology for EVs		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Switched Reluctance Motors: Switched Reluctance Motor construction , working operation, Speed control and torque of SR Motor, application of SR motor EVs. Stator Permanent Magnet Motor Drive, stator permanent magnet motor versus rotor permanent magnet motor, System configuration, doubly salient PM motor drive.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Operation and Electric Braking: Electric Drives and its parts, ,Classification of electric drives Speed-torque conventions and multi-quadrant operations Constant torque and constant power operation Purpose and types of electric braking, braking of DC shunt and Series motor, Dynamics during Starting and Braking: and energy loss during starting of DC motor. Methods of reducing energy loss during starting.		

Text Books:

1. K T Chau, "Electric Vehicle Motor Drive", IEEE Willey.
2. Mehrdad Ehsani & Ali Emadi, "Modern Electric, Hybrid Electric & Fuel Cell Vehicle", CRC Press
3. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House, 2nd edition, 2002.
4. S.K. Pillai ,"A First Course on Electric Drives" ,New Age International Publishers,3rd edition, 2012.
5. B.N. Sarkar, "Fundamental of Industrial Drives" ,Prentice Hall of India Ltd., 2012.

Reference Books:

1. M. Chilkin, "Electric Drives", Mir Publishers, Moscow.
2. Mohammed A. El- Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore, 2nd edition, 2017.
3. Morden power electronics and AC drives by B.K Bose, PHI .
4. V. Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill, 1994.

NPTEL Links:

1. Electric Drive by By Prof- Syama Prasad Das, IIT- KANPUR
   https://archive.nptel.ac.in/courses/108/106/108106182/
2. Electric Vehicle by Prof. Ashok Jhunjhunwala, IIT Madras
   https://archive.nptel.ac.in/courses/108/106/108106182/
3. Electric vehicle motor drive by Prof. Amit Jain, IIT Delhi
   https://archive.nptel.ac.in/courses/108/102/108102121/

ELECTRIC VEHICLE MOTORS AND DRIVES LAB (Minor) (PCC)				
LAB COURSE CONTENT				
ELECTRIC VEHICLE MOTORS AND DRIVES LAB		**Semester:**	**IV**	**Course Code: 417C**
Teaching Scheme:		**Examination scheme**		
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA: PR**		**25 marks**
		Internal Continuous Assessment (ICA) :CA		**25 marks**
End Semester Exam (ESE) Pattern:		**(Oral) OR**		

Concerned faculty member should suitably frame SEVEN laboratory assignments from the following list.

1. Speed Control of DC Shunt Motor.
2. Speed Control of DC Series Motor.
3. Reversal of direction of DC Motor.
4. Load test on DC Series motor.
5. Electrical braking of DC Motor.
6. Speed control of 3 phase induction motor drive.
7. Study of BLDC Motor.
8. Determination of Speed Torque characteristic of d.c .motor controlled using single phase half- controlled rectifier.
9. Study of stepper motor drive circuit.
10. Speed control of universal motor.
11. Study of vector control method for induction motor.
12. Study of reversible drives

Text Books:

1. K T Chau, “Electric Vehicle Motor Drive”, IEEE Willey.
2. Mehrdad Ehsani & Ali Emadi, “Modern Electric, Hybrid Electric & Fuel Cell Vehicle”, CRC Press
3. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House, 2nd edition, 2002.

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3. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House, 2nd edition, 2002.

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