Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree Offered by Different Programs

(In light of NEP 2020)

(NEP-Version II)

For students admitted in 2023-24 onwards

Implemented year-2024-25

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Near Kathora Naka, Amravati, Maharashtra

PIN 444604

Curriculum Structure for
Multi-Disciplinary Minor (MDM)
Degree in
Energy Engineering

(In light of NEP 2020)

(NEP_Version II)

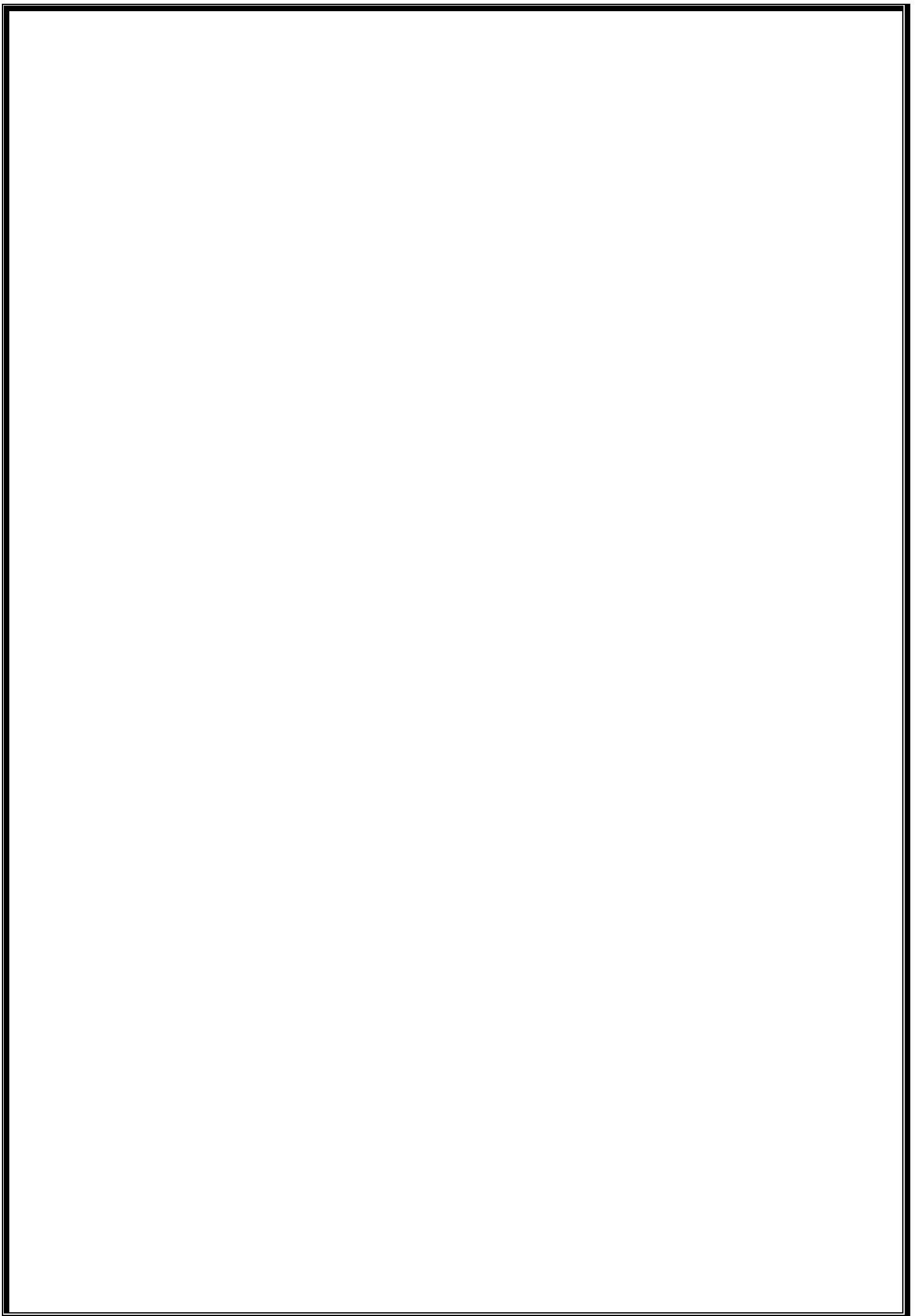## Offered By

DEPARTMENT OF
ELECTRICAL ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

Energy Engineering is a fast-growing and in-demand sector. This multidisciplinary minor caters to students who seek to comprehend the fundamentals of renewable energy, energy efficiency, and energy management, beyond the scope of engineering sciences and their respective core disciplines. The students will be able to understand the importance of the renewable energy industry and the world's transition to clean energy and more sustainable practices. It also aids in enabling other discipline engineers to play crucial roles in renewable energy, including the design and operation of wind turbines, solar panels, and other renewable energy systems, developing efficient energy storage solutions, and improving energy conversion technologies. It contributes to increasing the energy efficiency of electrical utilities and understanding the energy economics and reliability of renewable energy systems through advanced techniques and research in the field of renewable energy.

The students can apply the integration of knowledge, skills, and technological expertise of this minor with a major technology in the aligned branch to prepare for a wide variety of opportunities in energy sectors, projects, and in-demand careers while reducing the barriers between academics and industries.

B. Structure of the MDM course:

Electrical Department offers Multidisciplinary Minor Basket Track-1 (Energy Engineering)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme						Credits	
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	EE1315	Introduction to Renewable Energy	3			3	15	15	10	60			100	3
MM2	EE1415	Energy Resource, Environment and Economics	3			3	15	15	10	60			100	3
MM3	EE1515	Energy Efficiency in Electrical Utilities	3			3	15	15	10	60			100	3
MM4	EE1615	Energy Management	3			3	15	15	10	60			100	3
MM5	EE 1715	Project			4	4					100		100	2
Total			12	0	4	16	60	60	40	240	100	0	500	14

C. Eligibility Criteria:

Students enrolled in B. Tech. program other than **Electrical Engineering** are eligible. The allotment of minor degree Programme will be as per the policy of the Institute.

D. Intake: Minimum 15

E. Detailed Syllabus:

SEMESTER – III

Course Code	EE1315								Course category			MM
Course Name	**INTRODUCTION TO RENEWABLE ENERGY**											
Teaching Scheme				**Examination Scheme**								
Th	Tu	Pr	Total	Theory					Practical		Total	**Credits**
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:
1. Energy scenario, energy sources and their utilization.
2. Society's present needs and future energy demands.
3. Principles of renewable energy conversion systems.
4. Energy conservation methods.
5. Different renewable energy technologies

Course Contents:

Energy Scenario: Indian energy scenario, different forms of energy, principles of renewable energy, renewable energy availability in India, renewable energy sources and features.

Solar Thermal Systems: Introduction to Solar and Thermal Systems, Energy conversion Principle and applications, solar water heaters, space cooling, solar distillation, solar cooking, solar green house, solar production of hydrogen, simple illustrative numerical.

Solar Photovoltaic Systems: Operating principle, concept of PV cell, module, array and array combination. Applications, battery charging, pumping, lighting. Simple illustrative numerical.

Wind energy system: Principle of wind energy conversion. Basic components of wind energy conversion system, classification of wind energy conversion system and design concepts. Extraction of power. Simple illustrative numerical.

Energy Storage systems: Mechanical energy storage, electrical energy storage, chemical energy storage, electromagnetic energy storage, thermal energy storage, biological storage.

Energy conservation: Economic concept of energy, Principle of energy conservation, energy conservation technology, energy audit and co-generation.

Text Books:

1. S. P. Sukhatme, Solar Energy - Principles of Thermal Collection and Storage, Second Edition, Tata McGraw-Hill, New Delhi 1996.
2. G. D. Rai, Non-conventional Sources of Energy, Khanna Publications.
3. H. P. Gargand Jaipraksh, Solar Energy Fundamentals and Applications, Tata McGraw-Hill Publications
4. D. Mukharjee and S. Chakrabarti, Fundamentals of Renewable Energy Systems, New Age international Publication.
5. L. Umanand, Non-conventional Energy System, Web course: NPTEL, Course No. 22. Electrical Engineering Email: ums@cedt.iiisc.ernet.in.

Course Outcomes:

After completion of the course students will able to:

EE1315.1   Understand present energy scenario of India, energy sources/resources.
EE1315.2   Understand Society's present needs and future energy demands.
EE1315.3   Understand the Principles of renewable energy conversion systems.
EE1315.4   Understand energy conservation methods,
EE1315.5   Know about the energy auditing techniques.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1315.1	2	-	-	-	-	2	3	1	-	--	-	-	2	-	-
EE1315.2	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1315.3	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1315.4	2	2	1	2	2	2	3	1	-	2	3	-	2	-	1
EE1315.5	2	-	-	2	2	2	2	1	-	2	3	2	2	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

SEMESTER – IV

Course Code	EE1415						Course category			MM	
Course Name	**ENERGY RESOURCES, ENVIRONMENT AND ECONOMICS**										
Teaching Scheme				**Examination Scheme**							
Th	Tu	Pr	Total	Theory					Practical		Total	Credits
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:
1. The concept of different energy sources.
2. Present Indian energy scenario and energy policies.
3. Energy efficiency and environment.
4. The energy economics.
5. The future energy sources.

Course Contents:

Basics of energy and its various forms: Overview of Indian energy scenario, various forms of energy, major primary and secondary energy sources, other primary energy sources available, commercial and non-commercial energy sources, renewable and non-renewable energy sources, global primary energy reserves, strategies for better energy security of nation, introduction to energy conservation and its importance, economics reforms in coal, oil, natural gas and electricity, energy pricing in India, energy sector reforms, energy policy, energy regulation, energy forecasting, energy efficiency.

Energy and Environment: Air pollution, So_x, No_x, Co, CFC, water pollution, acid rain, green-house effect, carbon cycle, environmental consequences of fossil fuel use.

Global environmental concerns: Ozone layer depletion, its effects, global warming, implications of global warming (climate change), Co_2 emissions, impacts, mitigation, sustainability, clean development mechanism (CDM), prototype carbon fund (PCF).

Energy Economics: Cost factors, budgeting, standard costing, sources of capital, cash flow diagram, activity chart, simple payback period analysis, time value of money, net present value method, internal rate of return method, profitability index for benefit cost ratio. Simple illustrative numerical.

Future Energy Systems: Introduction to hydrogen, properties of hydrogen, sources of hydrogen, production of hydrogen, storage of hydrogen, Introduction to fuel cell.

Text Books:
1. Fowler, J. M., Energy and Environment, McGraw Hill, New York 1984.
2. Energy Management: W. R. Murphy, G. Mckay, Butteworths Heinemann. An imprint of Elsevier.
3. Guide book for National certification examination for energy managers and energy auditors. Bureau of energy efficiency.
4. Non-conventional energy sources: G. D. Rai, Khanna Publishers, Darya Gani, New Delhi.

Course Outcomes:

On completion of the course, students will be able to:

EE1415.1   Understand different sources of energy
EE1415.2   Understand energy pricing/marketing
EE1415.3   Understand the role of energy in the economy
EE1415.4   Understand energy economics and how to maintaining a balance between economic development and environmental quality
EE1415.5   Understand the importance of future energy sources.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1415.1	2	-	-	-	-	2	3	1	-	--	-	-	2	-	-
EE1415.2	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1415.3	2	2	1	2	2	2	2	1	-	2	3	-	2	-	1
EE1415.4	2	2	1	2	2	2	3	1	-	2	3	-	2	-	1
EE1415.5	2	-	-	2	2	2	2	1	-	2	3	2	2	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Curriculum Structure for
Multi-Disciplinary Minor (MDM)
Degree in
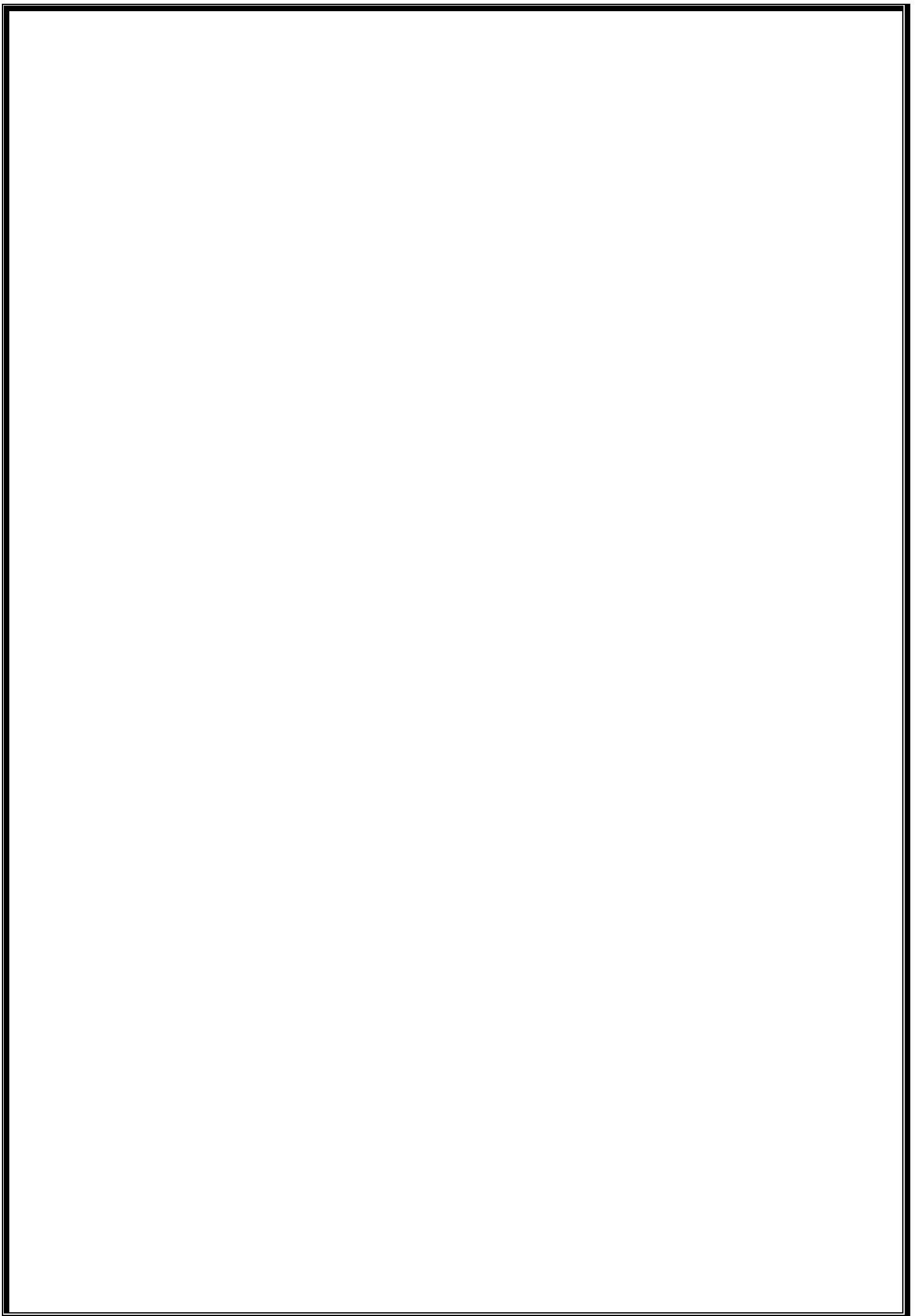# Electrical Motors and Drives

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF
ELECTRICAL ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

Electrical Machines and Drives are at the heart of our modern world, driving the technological advancements that have shaped our society. These systems are essential components in countless applications, ranging from industrial machinery and transportation to renewable energy generation. In addition to courses in engineering sciences and their respective core disciplines, this multidisciplinary minor caters to students who aspire to comprehend the fundamentals of electrical machines and drives, their diverse applications, and their crucial role in powering the world. It also helps other discipline engineers understand and inculcate the role of electric drives in optimizing machine energy consumption, reducing waste, and reducing environmental impact.

The students can apply the integration of knowledge, skills, and technological expertise of this minor with a major technology in the aligned branch to anticipate a future where electrical machines and drives play an even more significant role in the creation of a cleaner, more energy-efficient, and interconnected world.

B. Structure of the MDM course:

<table>
<tr><th colspan="15">Electrical Department offers Multidisciplinary Minor Basket
Track-2 (Electrical Machines and Drives)</th></tr>
<tr><th rowspan="3">Category</th><th rowspan="3">Course Code</th><th rowspan="3">Name of the Course</th><th colspan="4" rowspan="2">Teaching Scheme</th><th colspan="7">Evaluation Scheme</th><th rowspan="3">Credits</th></tr>
<tr><th colspan="4">Theory</th><th colspan="2">Practical</th><th>Total</th></tr>
<tr><th>TH</th><th>TU</th><th>PR</th><th>Total</th><th>CT1</th><th>CT2</th><th>TA</th><th>ESE</th><th>ICA</th><th>ESE</th><th></th></tr>
<tr><td>MM1</td><td>EE1316</td><td>Electric Motors</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM2</td><td>EE1416</td><td>Special Electrical Machines</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM3</td><td>EE1516</td><td>Power Electronics</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM4</td><td>EE1616</td><td>Electrical Drives and Control</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM5</td><td>EE1716</td><td>Project</td><td></td><td></td><td>4</td><td>4</td><td></td><td></td><td></td><td></td><td>100</td><td></td><td>100</td><td>2</td></tr>
<tr><td colspan="3">Total</td><td>12</td><td>0</td><td>4</td><td>16</td><td>60</td><td>60</td><td>40</td><td>240</td><td>100</td><td>0</td><td>500</td><td>14</td></tr>
</table>

C. Eligibility criteria:

Students enrolled in B. Tech. program other than Electrical Engineering are eligible. The allotment of minor degree Programme will be as per the policy of the Institute.

D. Intake: Minimum 15

E. Detailed syllabus:

SEMESTER – III

Course Code	EE1316					Course category			MM
Course Name	**ELECTRIC MOTORS**								
Teaching Scheme				**Examination Scheme**					
Th	Tu	Pr	Total	Theory				Practical	Total	**Credits**

Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	--	--	03	15	15	10	60	2hrs. 30min	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Constructional features and operating principle of ac and dc motors.
2. Characteristics of ac and dc motors for different operating conditions
3. Testing of ac and dc motors and calculation of performance parameters

Course Contents:

DC motor: Working principle, constructional details, classifications, voltage equation, Toque equation, speed equation, Factors affecting speed, speed control, Starting of DC motors, and different types of starters. Characteristics of DC motors – electrical characteristics, mechanical characteristics, performance characteristics. Losses and efficiency - Condition for maximum efficiency, Testing of DC motor, load test on DC motors, Swinburne's test, and Application of DC motors.

Induction Motor: Rotating magnetic field, motor construction, motor specifications, and types of motor, principle of operation, Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit, Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, and frequency). Methods of starting, braking and speed control for induction motors. Doubly-Fed Induction Machines.

Single Phase Induction Motor: Types, double field revolving theory, equivalent circuit, determination of motor parameters, methods of starting, applications.

Synchronous Motor: Principle of operation, constructional features and types, Principle of reversibility, voltage equation, phasor diagram, torque and power equations, steady state operating characteristic, 'V' and inverted 'V' curves, starting, hunting, damper windings and its effect, synchronous condenser, working principle of auto synchronous motor.

Text Books/References:

1. P. S. Bhimbra, Electrical Machinery, Khanna Publishers.
2. I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw-Hill..
3. M. G. Say, Performance and Design of Alternating Current Machines, CBS Publishers.
4. B. L. Theraja, Electrical Technology, Vol. – II, S. Chand & Co.
5. E. Fitzgerald, Electric Machinery, Tata McGraw-Hill.
6. NEMA, IEC and IS Standards.

Course Outcomes:

After completion of the course, the students will able to:

EE1316.1   Illustrate constructional features and operating principle of ac and dc motors.

EE1316.2   Analyze characteristics of ac and dc motors for different operating conditions.

EE1316.3   Analyze performance of ac and dc machine

EE1316.4   Test ac and dc motors and calculate its performance parameters,

EE1316.5   Analyze and select machine for specific application

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1316.1	3	1	1	3	--	--	--	--	--	--	--	--	1	3	--
EE1316.2	3	3	3	2	2	--	--	--	--	--	--	--	2	3	--
EE1316.3	3	3	3	2	2	--	--	--	--	--	--	--	2	3	--
EE1316.4	3	3	1	3	3	--	--	--	--	--	--	--	--	2	--
EE1316.5	3	3	2	3	1	--	--	--	--	--	--	--	--	3	--

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

SEMESTER – IV

Course Code	EE1416						Course category			MM
Course Name	SPECIAL ELECTRICAL MACHINES									
Teaching Scheme				Examination Scheme						
Th	Tu	Pr	Total	Theory					Practical		Total	Credits
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:
1. Construction, principle of operation, control and performance of stepping motors.
2. Construction, principle of operation, control and performance of switched reluctance motors..
3. Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.The energy economics.
4. Construction, principle of operation and performance of permanent magnet synchronous motors
5. Construction, principle of operation and performance of other special Machines.

Course Contents:

Stepper Motors: Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

Switched Reluctance Motors (SRM): Constructional features –Principle of operation-Torque prediction–Characteristics Steady state performance prediction – Analytical Method – Power controllers – Control of SRM drive - Sensor less operation of SRM – Applications.

Permanent Magnet Brushless D.C. motors: Fundamentals of Permanent Magnets-Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations-Power Converter Circuits and their controllers - Characteristics and control-Applications.

Permanent Magnet Synchronous Motors (PMSM): Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - Phasor diagram - Power controllers – performance characteristics -Digital controllers – Applications.

Other Special Machines: Constructional features – Principle of operation and Characteristics of Hysteresis motor- Synchronous Reluctance Motor–Linear Induction motor-Repulsion motor- Applications.

Text Books:
1. K. Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.
3. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

References:
1. R. Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
3. T. J. E. Miller, 'Brushless Permanent-Magnet and Reluctance Motor Drives', Oxford University Press, 1989.
4. R. Srinivasan, 'Special Electrical Machines', Lakshmi Publications, 2013.

Course Outcomes:

On completion of the course, students will be able to:

EE1416.1   Explore the knowledge of construction and operation of stepper motor in practical applications.
EE1416.2   Utilize the knowledge of construction, operation, and applications of stepper switched reluctance motors.
EE1416.3   Correlate the theory of the construction and operation of permanent magnet brushless D.C. motors in practice.
EE1416.4   Acquire the knowledge of construction and operation of permanent magnet synchronous motors
EE1416.5   Select a special machine for a particular application.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1416.1	3	3	3	3	-	-	1	1	-	2	-	3	3	3	3
EE1416.2	3	1	1	1	-	-	1	1	-	1	-	2	3	3	3
EE1416.3	3	3	3	3	-	-	1	1	-	2	-	3	3	3	3
EE1416.4	3	3	3	3	-	-	1	1	-	2	-	2	3	3	3
EE1416.5	3	3	3	3	3	-	2	1	-	3	-	3	3	3	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in Building Construction and Management

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF CIVIL ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

The Civil Engineering minor is tailored to students who want to understand the fundamentals of Civil Engineering other than courses covered in Engineering Sciences. The students will develop abilities in construction, drawings, estimating and construction management through foundation of Mathematics.

The students can combine the skills and technological expertise of this minor with a major in technology of aligned branch to prepare for a wide variety of opportunities in construction fields and in demand careers.

B. Structure of the MDM course:

<table>
<tr><th colspan="14">Civil Engg. Department offer Multidisciplinary Minor Basket , Track-1
(Building Construction & Management)</th></tr>
<tr><th rowspan="3">Category</th><th rowspan="3">Course Code</th><th rowspan="3">Name of the Course</th><th colspan="4" rowspan="2">Teaching Scheme</th><th colspan="7">Evaluation Scheme</th><th rowspan="3">Credits</th></tr>
<tr><th colspan="4">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>TH</th><th>TU</th><th>PR</th><th>Total</th><th>CT1</th><th>CT2</th><th>TA</th><th>ESE</th><th>ICA</th><th>ESE</th></tr>
<tr><td>MM1</td><td>CE1315</td><td>Multidisciplinary Minor-1 Basics of Civil Engineering</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM2</td><td>CE1415</td><td>Multidisciplinary Minor-2 Building Construction</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM3</td><td>CE1515</td><td>Multidisciplinary Minor-3 Building Planning & Drawing</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM4</td><td>CE1615</td><td>Multidisciplinary Minor-4 Building Estimates & Tendering</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM5</td><td>CE1715</td><td>Multidisciplinary Minor-5 Construction Management</td><td>2</td><td></td><td></td><td>2</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>2</td></tr>
<tr><td colspan="3">Total</td><td>14</td><td>0</td><td>0</td><td>14</td><td>75</td><td>75</td><td>50</td><td>300</td><td>0</td><td>0</td><td>500</td><td>14</td></tr>
</table>

C. **Eligibility criteria:** Students enrolled in B. Tech program other than Civil Engineering are eligible. The allotment of minor degree Programme will be as per the policy of the Institute.

D. Intake: Minimum 15,

E. **Detailed syllabus:**

Course Code	CE1315								Course category			MM1
Course Name	**Multidisciplinary Minor-1 Basics of Civil Engineering**											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives:

To make the students aware and understand:

1. Importance of Civil Engineering and role in Civil Engineer in infrastructure development and various branches / systems of Civil Engineering
2. Various activities in a Civil Engineering Project
3. Various construction materials and their applications in construction
4. Building Planning, drawings and Estimates

Course Contents:

Introduction: Introduction to Civil Engineering, Civil Engineering Projects, Role of Civil Engineer in construction activities, , Importance of Civil engineering in infrastructure development of the country

Investigations: Data collection for planning and design, Topographical investigations – surveying and levelling, Geological Investigations, Geotechnical Investigations, Hydrological Investigations,

Construction materials: Construction materials- Building stones, sand, aggregates, bricks –types and dimensions, Qualities of good bricks, Classification of bricks, cement-types and grades, mortar, P.C.C R.C.C- Grades, Solid and concrete blocks, ACC blocks, Reinforcement- Types and grades, M.S. Rolled steel sections, Aluminium sections, Roof coverings sheets, Flooring Tiles-types, Glass, Aluminium sections, Bitumen, Industrial timber products-veneer, Ply wood, particle board, fibre board, batten board, block board, pre-laminated boards, laminates

Building Planning, drawings and Estimates: Principles of planning, orientation, Introduction to building rules and bye laws, Building area terms-f plinth area and carpet area, Scales, Plan, Elevation, sections, dimensioning, construction notes, symbols for construction materials, Concept of Line plans, site plan and location plan, Units of measurements, Types of estimate- approximate and detailed

Branches of Civil Engineering: Basics of water resources engineering : Types of irrigation schemes, Types of Dams – Gravity dams and earth dams and their suitability, Bandhara

Basics of environmental engineering: Sources of water, Demand of water, Quality of water, waste water, Need of water treatment and waste water treatment

Basics of transportation engineering: Modes of Transportation - Roads, railways, bridges, tunnels and airports, docks and harbours , Typical cross sections of roads

Text Books:

1. Ramamrutham, Basic Civil Engineering, Dhanapatrai Publications, New Delhi, 2013
2. Bhavikatti S. S., Basic Civil Engineering, New Age Publication, 2010
3. Gopi S., Basic Civil Engineering, Pearson Education India, 2009
4. B. C. Punmia & Ashok Kumar Jain, Basic of Civil Engineering, Firewall Media, 2003

Reference Books and website links:

1. S.C. Rangwala, Engineering Materials, Charotar Publications, 2008
2. S.C. Rangwala, Engineering Materials, Charotar Publications
3. C. P. Kaushik, Basic of Civil and Environmental Engineering, , New Age Publication
4. M.S. Palanichamy, Basic Civil Engineering, McGraw Hill

Course Outcomes:

On completion of the course, students will be able to:

CE1315.1	Describe importance of Civil Engineering and role of Civil Engineer in infrastructure development
CE1315.2	Explain various types of investigations required for Civil Engineering projects
CE1315.3	Describe various building materials and their use/ application in Civil Engineering Constructions
CE1315.4	Explain basics of Civil engineering Planning, drawings and Estimates
CE1315.5	Describe various details related to branches of Civil Engineering

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE1315.1	0	0	0	0	0	1	0	0	0	2	0	1	2	3	1
CE1315.2	0	0	0	0	0	1	0	0	0	2	0	1	2	3	1
CE1315.3	0	0	0	0	0	1	0	0	0	2	0	1	2	3	1
CE1315.4	0	0	0	0	0	1	0	0	0	2	0	1	2	3	1
CE1315.5	0	0	0	0	0	1	0	0	0	2	0	1	2	3	1

0 - Not correlated   1 - Weakly Correlated   2 - Moderately Correlated   3 - Strongly Correlated

Course Code	**CE1415**								Course category			MM2
Course Name	**Multidisciplinary Minor-2 Building Construction**											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives:

To make the students aware and understand:
1. Basic concept of building construction

2. Various types of buildings according to National Building Code

3. Various components of building, their types and functions

4. Various construction processes

5. Special aspects of constructions

6. Temporary structures required for construction of various building components

Course Contents:

Introduction: Types of building as per National Building Code, Components of buildings and their functions, Types of structures-load bearing, framed and composite structures, their suitability, relative advantages and disadvantages

Foundation: Definition, purpose, Loads acting on foundation, Safe bearing capacity of soil-definition, Types of shallow foundation for buildings-spread footings for walls and columns, combined footing for columns, Raft foundation, Setting out for foundation.

Floors & Floor finishes: Floors- Definition & purpose, Types of R.C.C. floors-R.C.C. slab floor, R.C.C. slab & beam floor, Ribbed floor, Flat Slab, their suitability and construction procedure, Flooring tiles: Types-plain cement tiles, Mosaic tiles, chequered tiles, ceramic tiles, glazed tiles, P.V.C. flooring tiles, Vitrified Tiles

Doors Doors-Purpose, Criteria for location, Sizes, Types of door frames, Methods of fixing door frames, Types of door shutters- fully panelled, flush, louvered, glazed, sliding, revolving, rolling shutter, collapsible door, grilled door, suitability of different types of doors. Types of aluminium doors

Windows: Purpose, Criteria for location, Sizes, Types of wooden windows-casement, louvered, glazed, metal windows, Aluminium windows, Corner & bay windows, Ventilators-purpose and types, Grills for windows

Lintels: Lintels-purpose, types and their suitability, details of R.C.C. lintel

Stairs: Function, Technical terms, Criteria for location, Requirements of good stair, Types of stairs and their suitability, Design of stair, Lifts types and their suitability, Ramps, Escalators

Roofs: Flat & pitched roofs-suitability, Types of steel roof trusses and their suitability, Placing and fixing trusses, Types of roofing sheets, Fixing of roofing sheets to trusses

Masonry construction:

Brick Masonry: Qualities of good bricks, Field and laboratory tests on bricks, Classification of bricks, Mortars: Types of mortars and their suitability, Proportion of mortars used for different works, Technical terms in brick masonry, Principles to be observed during construction, Header bond, Stretcher bond, English Bond, Flemish bond (I & 11/2 brick thick walls), Construction procedure, defects in brick masonry

Reinforced Brick masonry: Applications, Advantages, Materials required, Construction

Concrete block masonry: Types-solid and hollow, common dimensions, Construction procedure

Plastering and pointing: Purpose, Types and their suitability, Procedure of plastering and pointing, Defects in plastering work

Damp proofing: Causes and effects, Methods of damp proofing, materials required, Water proofing compounds- suitability and uses. Details of cavity wall construction

Termite Proofing: Definition, Methods of Termite Proofing

Joints in structure: Construction joints-necessity, provision of construction joint in slab, beam and columns, Expansion joints -necessity, location, materials used, details of expansion joints at foundation and roof level for a load bearing and framed structure.

Formwork & scaffolding: Form work-types and suitability, Period for removal of formwork, scaffolding: necessity, Types, Details of erections

Text Books:

1. Sushil Kumar, Building Construction, 19thedition, Standard Publishers Distributors, New Delhi.2008
2. P.C. Verghese, Building Materials, , Ist edition, Prentice-Hall of India, New Delhi, 2009.
3. Saurabh Kumar S oni,, S. K. Kataria   and   Daryaganj,   Building   Materials   and Construction, New Delhi -11000

Reference Books:

1. National Building Code of India 2005, B.I.S., 2nd revision, Techniz Books International, New Delhi,2005
2. FPA 5000: Building Construction & Safety Code, FPA, Techniz Books International, New Delhi, 200.
3. Building Materials & Components for Developing Countries, C.B.R.I., Tata Mc- Graw Hill Publishing Co. New Delhi, 1990
4. Gurucharan Singh, Building Construction, 11 th Edition, Standard Book House, New Delhi 2010.

Course Outcomes:

After Completion of course students will be able to:

CE1415.1: explain various types of Buildings and their suitability

CE1415.2: classify and explain basic components of building

CE1415.3: Explain the importance and role of each component of building

CE1415.4: explain various construction processes for various construction works/
components

CE1415.5: Explain temporary structures required for construction of various building
components

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE1415.1	0	0	0	0	0	0	1	1	2	0	0	1	0	3	1
CE1415.2	0	0	0	0	0	0	1	1	2	0	0	1	0	3	1
CE1415.3	0	0	0	0	0	0	1	1	2	0	0	1	0	3	1
CE1415.4	0	0	0	0	0	0	1	1	2	0	0	1	0	3	1
CE1415.5	0	0	0	0	0	0	1	1	2	0	0	1	0	3	1

Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in Business Economics

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF CIVIL ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

The Civil Engineering minor is tailored to students who want to understand the fundamentals of Business Economics other than courses covered in Engineering Sciences. The students will develop abilities in Macroeconomics, Microeconomics, Business Statistics, and Financial accounting through foundation of Mathematics.

The students can combine the skills of this minor with a major in technology of aligned branch to prepare for a wide variety of opportunities in industrial fields and in demand careers.

B. Structure of the MDM course:

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme						Total	Credit
							Theory				Practical			
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	CE1316	Multidisciplinary Minor-1 Principles of Macroeconomics	3			3	15	15	10	60			100	3
MM2	CE1416	Multidisciplinary Minor-2 Principles of Microeconomics	3			3	15	15	10	60			100	3
MM3	CE1516	Multidisciplinary Minor-3 Business Statistics	3			3	15	15	10	60			100	3
MM4	CE1616	Multidisciplinary Minor-4 Financial Accounting	3			3	15	15	10	60			100	3
MM5	CE1716	Multidisciplinary Minor-5 Minor Project			4	4					50	50	100	2
Total			**12**	**0**	**4**	**16**	**60**	**60**	**40**	**240**	**50**	**50**	**500**	**14**

Title of table: **Civil Engg. Department offer Multidisciplinary Minor Basket , Track-2 (Business Economics)**

C. **Eligibility criteria:** Students enrolled in B. Tech program of any branch are eligible. The allotment of minor degree Programme will be as per the policy of the Institute.

D. Intake: Minimum 15,

Course Code	**CE1316**					Course category			MM1
Course Name	**Multidisciplinary Minor-1 Principles of Macroeconomics**								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Description: This course introduces students to the fundamental concepts of macroeconomics, focusing on the behavior of economics as a whole.

Course Objectives:

To make the students aware and understand:

1. core economic concepts like scarcity, opportunity cost, and GDP
2. methods for calculating GDP and interpret its components
3. factors affecting economic growth and development.
4. causes and consequences of unemployment and inflation
5. role of fiscal and monetary policy in stabilizing the economy

Course Contents:

Introduction to Macroeconomics: Definition, Meaning, Core Economic Concepts - Scarcity, Opportunity Cost, Economic Systems - Capitalism, Socialism, Mixed Economies)

Measurement of Economic Activity: Gross Domestic Product (GDP) and its Components, Methods of Calculating GDP, Understanding Inflation and Deflation

Economic Growth and Development: Factors Affecting Economic Growth, Challenges to Economic Growth (Income Inequality, Resource Depletion), Introduction to Development Economics

Unemployment and Inflation: Types of Unemployment (Frictional, Structural, Cyclical), Causes and Consequences of Unemployment, Understanding Inflation, and its Measurement, The Phillips Curve

Fiscal Policy and Monetary Policy: Role of Government in the Economy, Fiscal Policy Tools (Taxes, Government Spending), Role of Central Bank, Monetary Policy Tools (Interest Rates, Reserve Requirements)

International Trade and Finance: Benefits and Challenges of Free Trade, Balance of Payments, Exchange Rates and Foreign Exchange Market

Textbooks:

1. David Colander, Macro Economics, McGraw Hill Education Private Limited (Latest Edition)
2. D. N. Dwivedi, Macro Economics: Theory and Policy, McGraw Hill Education Private Limited (Latest Edition)
3. H. L. Ahuja, Macro Economics: Theory and Policy, S. Chand & Company Limited. (Latest Edition)
4. M. L. Jhingan, Macro Economic Theory, Vrinda Publications Private Limited (Latest Edition)

Reference Books:

1. Ben Fine & Ourania Dimakou, Macroeconomics: A Critical Companion, Pluto Press (Latest Edition)
2. Brian Snowdon & Howard Vane (2003), The Development of Modern Macroeconomics: A Rough Guide, in Macroeconomics: A Reader, (Ed.)
3. Brian Snowdon and Howard Vane, Routledge • Wavare Anil Kumar & V.Kumbhar ,(2019) Macro Economics, Ruby Publisher, Kolhapur, MS, India.

Course Outcomes:

On completion of the course, students will be able to:

CE1316.1	Define core economic concepts like scarcity, opportunity cost, and GDP
CE1316.2	Explain the methods for calculating GDP and interpret its components
CE1316.3	Analyse the factors affecting economic growth and development
CE1316.4	Evaluate the causes and consequences of unemployment and inflation
CE1316.5	Discuss the role of fiscal and monetary policy in stabilizing the economy

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE1316.1	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1316.2	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1316.3	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1316.4	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1315.5	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1

0 - Not correlated   1 - Weakly Correlated   2 - Moderately Correlated   3 - Strongly Correlated

Course Code	**CE1416**								Course category			MM2
Course Name	**Multidisciplinary Minor-2 Principles of Microeconomics**											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Description:

This course introduces students to the principles of microeconomics, focusing on individual decision-making and market behavior.**Course Contents:**

Course Objectives:

To make the students aware and understand:
1. statistical methods to interpret and analyze business dataHighway planning, engineering surveys, and geometric design of roads

2. central tendency and dispersion to describe data sets.

3. probability concepts and common probability distributions to solve business problems

4. hypothesis testing and interpret statistical significance for business decisions

5. linear regression models to analyze relationships between variables

Course Contents:

Introduction to Microeconomics: Definition, Meaning, Basic Economic Concepts (Demand, Supply, Market Equilibrium), Consumer Choice Theory (Utility Maximization)

Demand and Supply Analysis: Factors Affecting Demand and Supply, Market Equilibrium and Price Changes, Elasticity of Demand and Supply

Market Structures: Perfect Competition vs. Imperfect Competition (Monopoly, Monopolistic Competition, Oligopoly), Market Power and Price Determination in Different Market Structures

Production and Costs: Production Functions and Short-Run vs. Long-Run Costs, Economies of Scale and Diseconomies of Scale, Cost-Minimization Strategies for Firms

Market Failure and Government Intervention: Externalities (Positive and Negative), Public Goods and Common Pool Resources, Role of Government in Regulating Markets

Behavioral Economics and Applications: Introduction to Behavioural Economics, Effect of Psychological Factors on Consumer Decisions, Application of Microeconomic Principles to

Textbooks:

1. Ahuja H.L.: Modern Micro Economics, S. Chand & Company Ltd New Delhi

2. Jhingan M.L., Micro Economic Theory, Virinda Publication, Delhi.

3. Mansfield, E., Microeconomics, W.W. Norton and Company, New York.

4. Koutsoyiannis, A., Modern microeconomics, Macmillan, London.

Reference Books:
1. Lipsey & Cristal, Introduction to Positive Economics, Oxford Press.

2. Jack Hirshlifer, Price Theory and Applications, Prentice Hall of India Pvt. Ltd. Delhi

3. K.K. Dewett, Modern Economics Theory, S. Chand Publications, New Delhi.

4. KPM Sundaram and E. N. Sundaram, Micro Economics, S. Chand Publication, New Delhi.

5. Seth M. L. : Micro Economics, Lakshmi Narain Agrawal Publisher Real-World Issues

Course Outcomes:
        After Completion of course students will be able to:
CE1416.1: differentiate between microeconomics and macroeconomics and explain basic economic concepts (demand, supply, market equilibrium)
CE1416.2: analyze the factors affecting demand and supply and predict their impact on market equilibrium
CE1416.3: compare and contrast different market structures (perfect competition, monopoly, etc.) and explain price determination under each structure
CE1416.4: evaluate the production process, cost structures, and strategies for cost minimization.
CE1416.5: identify market failures and explain how government intervention can improve market efficiency

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE1416.1	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1416.2	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1416.3	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1416.4	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1
CE1416.5	0	0	0	0	0	0	0	0	0	0	3	1	0	0	1

Curriculum Structure for
Multi-Disciplinary Minor (MDM)
Degree in
Mechanical Engineering

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF MECHANICAL ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

The mechanical engineering minor is tailored to students who want to understand the fundamentals of mechanical engineering other than courses covered in engineering sciences. The students will develop abilities in design, analysis and experimentation through foundation of math, physics, chemistry including modelling, energy engineering, mechanics of materials, product design and hydraulics.

The students can combine the skills and technological expertise of this minor with a major in technology of aligned branch to prepare for a wide variety of opportunities in industrial fields and in demand careers.

B. Structure of the MDM course:

ME Department offer Multidisciplinary Minor Basket , Track-1 (Mechanical Engineering)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	ME1315	Production Technology	3			3	15	15	10	60			100	3
MM2	ME1415	New and Renewable Energy Sources	3			3	15	15	10	60			100	3
MM3	ME1515	Automobile Engineering	3			3	15	15	10	60			100	3
MM4	ME1615	Basic of Product Design	3			3	15	15	10	60			100	3
MM5	ME1715	Industrial Management and Quality Control	2			2	15	15	10	60			100	2
Total			**14**	**0**	**0**	**14**	**75**	**75**	**50**	**300**	**0**	**0**	**500**	**14**

C. Eligibility criteria:
Students enrolled in B. Tech program other than Mechanical Engineering are eligible. The allotment of minor degree Programme will be as per the policy of the Institute. Intake: Minimum 15,   E **Detailed syllabus:**

Course Code	ME1315							Course category		MM1
Course Name	PRODUCTION TECHNOLOGY									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
03	00	00	03	15	15	10	60	2 hrs 30 min	0	0	100	03

Course Objectives

I. To identify the necessity and importance of manufacturing.
II. To learn the fundamentals of major classes of manufacturing processes.
III. To understand the working principles of different casting and welding operations
IV. To differentiate between these processes in terms of application, function, advantages,
     Disadvantages, quality and productivity

Pattern and Mould Making: Introduction to basic manufacturing processes, Pattern materials, allowances, Types of patterns,. Basic principle and Terminology of sand casting, gating system, types of gate , Directional and Progressive solidification. General properties of moulding sands, Types of sands, Preparation of sand moulds of different types.

Casting methods: Permanent mold casting, slush casting, shell molding, Investment or lost wax casting, vacuum process, centrifugal casting, Continuous casting, Die casting equipment's and processes for Gravity, pressure and vacuum casting methods, Comparison between casting methods. Defects in casting: Inclusions and sand defects, Gas defects, shrinkage defects, contraction defects.

Forming Processes: Principle and working of Hot and cold working processes. Different types of hot and cold working processes.

Welding Processes: Introduction to welding processes: working principle and applications of Arc welding, TIG welding, MIG- welding, Gas-Welding, Resistance welding. Introduction to riveting, soldering and brazing.

Machining Processes: Working of Lathe, Drilling and Milling machine. Various machining operations, Introduction to CNC Lathe and Milling machine

Text Books:
1. Manufacturing Process-II H. S.Bawa, 3 rd Edition, Tata Mc Graw hill Publishing Co. Ltd.2004
2. Workshop Technology-I, B. S. Raghuwanshi, 2 nd Edition, Dhanpat Rai and Sons, 2001

References Books:
1. Manufacturing Science Ghosh and Malik, Affiliated East – West PressLtd, 3rd Edition, 2002
2. Processes and Materials of Manufacture, R A LindBerg, 2nd Edition,PHI Pub 2001
3. Rao P N Manufacturing Technology : Metal Cutting and Machine tools, 3rd Edition, Tata McGraw Hill 2001
4. Workshop Technology, Hajra Chaudhary, 4 th Edition, Dhanpat Rai and Sons 2001

Course Outcomes:
After completion of course, student will be able to:
ME 1315.1 Able to understand principles of casting, forming, welding and plastic processing.
ME 1315.2 Able to understand advantages and limitations of casting, forming, welding Processes.
ME 1315.3 Able to understand cause and remedies for different types of defects in cast,
          Formed, welded product.

ME 1315.4 Able to select appropriate manufacturing process based on function, material,
                Quality requirement, production volume of a product.

ME 1315.5 Able to find out defects in welding and understand surface treatment

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME 1315.1	2	2	-	-	-	-	1	-	-	-	-	-	2	1	-
ME 1315.2	3	2	-	-	--	-	-	-	-	-	-	-	2	2	-
ME 1315.3	2	3	-	-	--	-	1	-	-	-	-	-	3	1	-
ME 1315.4	2	1	1	-	-	1	2	-	-	-	-	1	3	-	-
ME 1315.5	2	2	1	-	-	-	1	-	-	-	-	1	2	1	-

0 - Not correlated   1 - Weakly Correlated   2- Moderately Correlated 3- Strongly Correlated

Course Code	ME1415								Course category			MM2
Course Name	**NEW AND RENEWABLE ENERGY SOURCES**											
Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

I. To identify different renewable energy sources and to understand world as well as Indian energy scenario.
II. To study the basic concepts of solar radiation and to understand the various applications of solar energy.
III. To learn principles of energy conversion from alternate sources including wind, biomass, biogas, geothermal, ocean,
IV. To study the concepts and applications of fuel cells.
V. To study the concepts and applications of thermoelectric convertor and MHD generator.

Course Contents:

Introduction: Need to adopt renewable energy. Various renewable energy sources and current energy scenario of India, Role and potential of new and renewable source.

Principles of solar radiation: basic concepts of solar energy, the solar constant, extra-terrestrial and terrestrial solar radiation, basic solar geometry, instruments for measuring solar radiation and sun shine, solar radiation data.

Solar energy collection: classification, Study of flat plate and concentrating collectors, Applications of various collectors

Solar energy storage: Various ways of energy storage, Sensible, latent heat and stratified storage, solar ponds.

Solar thermal Applications: solar water heaters, solar cockers, solar dryers, Solar thermal power plant

Solar photovoltaic systems: Solar cell fundamentals, classification, solar photovoltaic systems and its applications.

Wind Energy: Introduction, Basics of Wind Energy Conversion, Current status and future prospects, -Classification of wind turbines, Aerodynamics of wind turbines, performance characteristics, Betz criteria. Wind energy conversion systems, Advantages and drawbacks of wind energy

Bio-Mass: Principles of Bio-Conversion, usable forms of biomass and conversion technologies, Anaerobic/aerobic digestion, Bio-gas digesters, biomass gasification, biomass to ethanol production, biomass to biodiesel production.

Fuels cells: Principle, construction, working, classification, advantages and disadvantages. Review of hydrogen as future energy source

Other renewable energy sources: geothermal energy, Ocean energy , Direct energy conversion magneto- hydrodynamic (MHD)

Text Books:

1. Non conventional Energy Reseources, B. H. Khan, Tata McGraw-Hill Education

2. Solar Energy, Sukhatme & Nayak Tata McGraw-Hill Education,

3. Non-Conventional Energy Sources, G.D. Rai,

Reference Book:

1.   Renewable Energy Resources, John Twidel& Anthony D. Weir, 2nd Edition, Talor & Francis,

2. Principles of Solar Energy, D. Yogi Goswami, Frank Krieth& John F Kreider,

3.A. Duffie and W.A. Beckman, Solar Energy - Thermal Processes, John Wiley,

4. H.P.Garg & J.Prakash,, Solar Energy fundamental & applications., Tata McGraw Hill
   Publication

Course Outcomes:

Upon successful completion of this course student should be able to :

ME1415.1 Identify renewable energy sources and their utilization in India

ME1415.2 Apply basic principles to design solar thermal and photovoltaic systems

ME1415.3 Illustrate the concept of wind energy conversion

ME1415.4 Analyse the working of energy conversion system using various alternative sources
             like biomass, geothermal, ocean and MHD

ME1415.5 Explain the concepts and applications of hydrogen as afuel and various fuel cells,

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME1415.1	3	3	2	0	0	0	0	0	0	0	0	0	3	2	0
ME14152	3	0	3	3	0	0	0	0	0	0	0	0	2	3	0
ME1415.3	3	0	2	0	0	0	0	0	0	0	0	0	0	3	0
ME1415.4	2	1	2	1	0	0	0	0	0	0	0	0	0	1	0
ME1415.5	2	0	2	3	0	0	0	0	0	0	0	0	0	2	0

   0 - Not correlated   1 - Weakly Correlated   2 - Moderately Correlated   3 - Strongly Correlated

Curriculum Structure for
Multi-Disciplinary Minor (MDM) Degree in Automation and Robotics

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF MECHANICAL ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

The mechanical engineering minor is tailored to students who want to understand the fundamentals of mechanical engineering other than courses covered in engineering sciences. The students will develop abilities in design, analysis and experimentation through foundation of math, physics, chemistry including modelling, energy engineering, mechanics of materials, product design and hydraulics.

The students can combine the skills and technological expertise of this minor with a major in technology of aligned branch to prepare for a wide variety of opportunities in industrial fields and in demand careers.

B. Structure of the MDM course:

ME Department offer Multidisciplinary Minor Basket , Track-2 (Automation and Robotics)													
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	ME1316	Hydraulics and Pneumatics	3			3	15	15	10	60			100	3
MM2	ME1416	Automation in Manufacturing	3			3	15	15	10	60			100	3
MM3	ME1516	Mechatronic Systems	3			3	15	15	10	60			100	3
MM4	ME1616	Industrial Robotics	3			3	15	15	10	60			100	3
MM5	ME1716	Computer Integrated Manufacturing	2			2	15	15	10	60			100	2
Total			14	0	0	14	75	75	50	300	0	0	500	14

Eligibility criteria: Students enrolled in B. Tech program other than Mechanical Engineering are eligible. The allotment of minor degree Programme will be as per the policy of the Institute. Intake: Minimum 15,**Detailed syllabus:**

Course Code	ME1316								Course category		MM1
Course Name	**HYDRAULICS AND PNEUMATICS**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objective:

I. To understands the basic features and functions of Hydraulic motors.

II. To understands the working of actuators and flow control valves.

III. To learn the difference between   hydraulics and pneumatic circuit.

IV. To study the concept of pneumatic circuit and system.

VI. To apply various methods for trouble shooting of hydraulic and pneumatic systems

Course contents :

Hydraulic Actuators and Control Component: Hydraulic Actuators: Cylinders - Types and construction, Application, Hydraulic cushioning - Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves - Types, Construction and Operation -   servo and Proportional valves - Applications - Accessories: Reservoirs, Pressure Switches - Applications - Fluid Power A SI Symbols - Problems.

Hydraulic Circuits and Systems: Accumulators, Intensifiers, Industrial hydraulic circuits - Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil. Sequence. Reciprocation, Synchronization. Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

Pneumatic and Electro Pneumatic Systems: Properties of air - Perfect Gas Laws - Compressor - Filters. Regulator, Lubricator. Muffler, Air control Valves, Quick Exhaust Valves, and Pneumatic actuators. Design of Pneumatic circuit - Cascade method - Electro Pneumatic System - Elements - Ladder diagram - P r o b l e m s , Introduction to fluidics and pneumatic logic circuits.

Trouble shooting and Applications: Installation, election. Maintenance. Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits (or Drilling. Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools - Low cost Automation - Hydraulic and Pneumatic power packs.

Text Book:

1. Fluid Power with Applications, Anthony Esposito, Pearson Education 2005.
2. Oil Hydraulics Systems- Principles and Maintenance, Majumdar S.R.,Tata McGraw-Hili. 2001.

Reference Books:

I. Pneumatic controls. Joji,P .. Wiley India Pvt. Ltd .. 2008.
2. Oil Hydraulic Power and its Industrial Applications, Ernst, W.,   ew York. McGraw Hill.

3. Design of Hydraulic Control Systems, Lewis, E. E., and H. Stern, New York, McGraw I-lill..
4. Hydraulic and Pneumatic Controls. Shanmugasundararn. K. Chand & Co, 2006.
5. The analysis and Design of Pneumatic Systems, Blaine W. Andersen., John Wiley and Sons, Inc.
6. Fluid Power Control, Blackburn, F.G. Reethof, and J.L. Shearer, , New York, Technology Press of M. I. T.

Course Outcomes:

On completion or course. Student will be able to:

ME1316.1.   Explain the working of hydraulic motor
ME1316.2   Summarize the features and functions actuators and Flow control valves.
ME1316.3   Explain the different types or Hydraulic circuits and systems.
ME1316.4   Explain the working of different pneumatic circuits and systems.
ME1316.5.   Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

CO-PO - PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME1316.1	3	3	2	0	0	0	0	0	0	0	0	0	3	2	0
ME1316.2	3	0	3	3	0	0	0	0	0	0	0	0	2	3	0
ME1316.3	3	0	2	0	0	0	0	0	0	0	0	0	0	3	0
ME1316.4	2	1	2	1	0	0	0	0	0	0	0	0	0	1	0
ME1316.5	2	0	2	3	0	0	0	0	0	0	0	0	0	2	0

Course Code	ME1416								Course category			MM2
Course Name	**AUTOMATION IN MANUFACTURING**											
Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course objective:
I.   To impart the concept of automation in manufacturing systems.
II.   To inculcate the knowledge of Group Technology and automation.
III. To acquire the fundamental concepts of hydraulic systems, actuators their design and control devices, sequence and their operation.
IV.   To induce the knowledge of rapid prototyping Technology and automated assembly system

Course contents:
Introduction: Definition, concepts of automation, Automation in manufacturing System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Introduction to automated material handling and storage – ASRS, AGV.

Types of Automation - Automation strategies, Group Technology & Coding Methods, Flexible Manufacturing System – Types, Advantages, Limitations. Computer Integrated Manufacturing and Computer Aided Process Planning.

Rapid Prototyping: Introduction to Rapid Prototyping, classification of RP Processes, working principle, models &specification process, application, advantages & disadvantages, Stereo Lithography Apparatus (SLA), Laminated Object Manufacturing,(LOM), 3D Printing, Fused Deposition Modelling (FDM). Rapid Tooling and STL format.

Planning issues: components of FMS, types of flexibility, tradeoffs, computer control and functions, planning, scheduling and control of FMS, scheduling and knowledge-based scheduling. Hierarchy of computer control, supervisory computer, introduction to turning center, machining center, cleaning and deburring equipment, coordinate measuring machines: types, working and capabilities.

Characteristics of JIT: Pull method, small lot sizes, work station loads, flexible work force, line flow strategy. supply chain management Preventive maintenance - Kanban system, value engineering, MRD JIT, lean manufacture, quality concepts and management

Automated assembly System: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine. Automated Inspection and Testing: Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods.

Text books:
1.   Mikell P Groover, "Automation, Production System and Computer Integrated Manufacturing", Prentice Hall Publications, ISBN 81-203-0618-X, 2014
2.   Robot and Manufacturing Automation, C. Ray Asfahl ,Amazon,
3.   Assembly Automation and Product Design, Geoffrey Boothroyd,
4.   Industrial hydraulic control, Peter Rohner, Wiley

Reference books:
1.   Automatic Assembly. Boothroyd , C. Poli, L. Murch, Marcel Dekker Inc.
2.   Mechanization by pneumatic control, Werner Deport and Kurt Stool, Vol. I and II.
3.   Introduction to Manufacturing Technology, Date P. P., Principles and Practices, Jayco Publishers, Mumbai

Course Outcomes: Upon completion of this course the student will be able to:

ME1416.1 understand the concept of Automaton and apply them in the integration of various manufacturing Processes.

ME1416.2 Implement the various classification and types of automation strategies.

ME1416.3 Apply the Knowledge acquired in the fundamental concepts of hydraulic automation, their design and control devices, sequence and their operation through computer control.

ME1416.4 Analyse various automated flow lines, Explain assembly systems and line balancing methods and Automatic assembly.

ME1416.5 Apply the Knowledge acquired in rapid prototyping and programmable logic controllers.

CO – PO –PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME1416.1	3	2	2	2	0	1	0	0	0	0	0	2	1	2	0
ME1416.2	2	1	3	3	0	2	0	0	0	0	0	1	0	0	1
ME1416.3	2	2	2	2	0	0	0	0	0	0	0	1	0	1	0
ME1416.4	3	2	3	2	0	2	0	0	0	0	0	1	1	0	0
ME1416.5	2	2	2	2	0	0	0	0	0	0	0	0	0	1	0

0 - Not correlated   1 - Weakly Correlated   2 - Moderately Correlated   3 - Strongly Correlated

Curriculum Structure for
Multi-Disciplinary Minor (MDM) Degree in Industrial Management

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF MECHANICAL ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

The mechanical engineering minor is tailored to students who want to understand the fundamentals of mechanical engineering other than courses covered in engineering sciences. The students will develop abilities in design, analysis and experimentation through foundation of math, physics, chemistry including modelling, energy engineering, mechanics of materials, product design and hydraulics.

The students can combine the skills and technological expertise of this minor with a major in technology of aligned branch to prepare for a wide variety of opportunities in industrial fields and in demand careers.

B. Structure of the MDM course:

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme						Total	Credits
							Theory				Practical			
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	ME1317	Organizational Behavior	3			3	15	15	10	60			100	3
MM2	ME1417	Human Resource Management	3			3	15	15	10	60			100	3
MM3	ME1517	Material Management	3			3	15	15	10	60			100	3
MM4	ME1617	Marketing Management	3			3	15	15	10	60			100	3
MM5	ME1717	Corporate Financial Reporting and Analysis	2			2	15	15	10	60			100	2
Total			**14**	**0**	**0**	**14**	**75**	**75**	**50**	**300**	**0**	**0**	**500**	**14**

Spanning title row: **ME Department offer Multidisciplinary Minor Basket , Track-3 (Industrial Management)**

Eligibility criteria: Students enrolled in B. Tech program of all branches are eligible. The allotment of minor degree Programme will be as per the policy of the Institute. Intake: Minimum 15, **Detailed**

Course Code	ME1317								Course category		MM1	
Course Name	**ORGANISATIONAL BEHAVIOUR**											
Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

    I. To develop understanding of individual and group behaviour in the organisation

    II. To study the basic concepts of organisation behaviour and its application in organisation.

    III. To learn principles of leadership and Power

    IV. To study the Factors affecting organizational climate

    V. To study the concepts and applications of prevention and management of stress

Introduction to organizational behavior: Definition, need and importance of organizational behavior, Nature and scope, Frame work: Organizational behavior models, Organization and the environmental factors. Organizational Theory, Organizational behavior modification. Misbehavior –Types

Individual Behavior: Personality, Types factors influencing personality Theories. Learning, Types of learners, the learning process – Learning theories. Attitudes: Characteristics Components, Formation, Measurement, Values. Perceptions: Importance, Factors influencing perception, Interpersonal perception Impression Management. Emotions and Moods in workplace

Group Behavior: Organization structure, Formation, Groups in organizations, Influence Group dynamics, Interpersonal Communication. Team building, Interpersonal relations, Group decision making techniques. Meaning of conflict and its types, Conflict Redressed process.

Leadership and Power: Leadership Meaning, importance, traits, styles and Theories. Leaders Vs Managers. Sources of power, Power centers, Power and Politics. Motivation at work importance, need, types and its effects on work behavior. Motivation Theories: Maslow's, Herzberg, etc.

Dynamics of Organizational Behavior: Organizational culture and climate, Factors affecting organizational climate, Importance. Organizational change, Importance, Stability Vs Change, Proactive Vs Reaction change, the change process, Resistance to change, Managing change.

Text Books:
1. Human Behavior at work Keith Devis, McGraw Hill 1997
2. Organizational Behavior; Concepts, Skills and Practices Kinicki Kreitner, McGraw Hill 1997.

Reference Book :
1. Dimension of Organizational Behavior T. Herbert Organization & Management R. D. Agrawal
2. Organizational Behavior and Performance Aszilagyl & Walace Organizational Behavior K. Aswathapa

Course Outcomes:

Upon successful completion of this course student should be able to:

1. ME1317.1 Identify the behaviour of an individual in the organisation
2. ME1317.2 Apply basic principles of organisational behaviour in the organisation
3. ME1317.3 Illustrate the concept of leadership and power in the organisation
4. ME1317.4 Analyse the dynamics of behaviour for good organisational culture and Climate.
5. ME1317.5 Explain the concepts and applications of stress management for Balancing work and life.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME1317.1	3	3	2	0	0	0	0	0	0	0	0	0	3	2	0
ME1317.2	3	0	3	3	0	0	0	0	0	0	0	0	2	3	0
ME1317.3	3	0	2	0	0	0	0	0	0	0	0	0	0	3	0
ME1317.4	2	1	2	1	0	0	0	0	0	0	0	0	0	1	0
ME1317.5	2	0	2	3	0	0	0	0	0	0	0	0	0	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated   3 - Strongly Correlated

Course Code	ME1417						Course category				MM2
Course Name	**HUMAN RESOURCES MANAGEMENT**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives
I. To understand and appreciate the importance of the human resources vis-a-vis other resources of the organization
II. To familiarize the students with methods and techniques of HRM
III. To equip them with the application of the HRM tools in real world business situations.
IV. To study the methods of Human Resource Development
V. To understand the importance of collective bargaining

Human Resources Management: Context and Concept of People Management in a Systems Perspective, Organization and Functions of the HR and Personnel Department, HR Structure and Strategy; Role of Government and Personnel Environment including MNCs.

Recruitment and Selection : Human Resource Information System [HRIS], Manpower Planning, Selection, Induction & Orientation, Performance and Potential Appraisal, Coaching and Mentoring, HRM issues and practices in the context of Outsourcing as a strategy

Human Resources Development : Training and Development Methods, Design & Evaluation of T&D Programmes, Career Development, Promotions and Transfers, Personnel Empowerment including Delegation, Retirement and Other Separation Processes.

Financial Compensation: Productivity and Morale, Principal Compensation Issues & Management, Job Evaluation, Productivity, Employee Morale and Motivation, Stress Management, Quality of Work Life.

Building Relationships: Facilitating Legislative Framework, Trade Unions, Managing Conflicts, Disciplinary Process, Collective Bargaining, Workers Participation in Management - Concept, Mechanisms and Experiences.

Text books
1. Venkata Ratnam C. S. & Srivatsava B. K.,Personnel Management And Human Resources, Tata Mc-Graw Hill, NewDelhi,,
2. Aswathappa, Human Resource Mangement, Tata McGraw Hill, NewDelhi, 2010

Reference book:
1. Garry Dessler &Varkkey, Human Resource Management, Pearson, New Delhi, 2009
2. Alan Price, Human Resource Management, Cengage Learning, NewDelhi, 2007.

Course Outcomes:

Upon successful completion of this course student should be able to:

1. ME1417.1 Understand the function of personnel department
2. ME1417.2 Undertake manpower planning , recruitment and performance appraisal
3. ME1417.3 Design and evaluate training and development methods
4. ME1417.4 Identify training need on stress management, motivation to improve quality of work.
5. ME1417.5 Evaluate the functions of trade union.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME1417.1	3	2	2	0	0	0	0	0	0	0	0	0	3	2	0
ME1417.2	3	3	2	3	0	0	0	0	0	0	0	0	2	3	0
ME1417.3	3	0	3	0	0	0	0	0	0	0	0	0	0	2	0
ME1417.4	2	1	3	1	0	0	0	0	0	0	0	0	0	1	0
ME1417.5	2	0	3	2	0	0	0	0	0	0	0	0	0	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated   3 - Strongly Correlated

Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in Internet of Things

(In light of NEP 2020)

(NEP_Version II)

Offered By

Department of Electronics & Telecommunication Engineering

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. **Preamble:**

IoT is a potential remedy for making the life of people better. Data exchange between the machines not only makes information more accessible, but it also has the potential to improve safety, health, education, and other elements of daily life. The smart watch, which keeps a connection to the cloud while monitoring health, is an example of this. Communication between the embedded systems offer the potential to boost efficiency, develop fresh manufacturing approaches, and get a deeper understanding of the market in sectors and businesses that deal directly with the end consumer. In the current technology scenario, IoT is gaining importance due to the features such as:

Better Decision Making
Real-time Tracking and Monitoring
Automation
Security and Privacy

B. **IoT skill set**

IoT Skill Set

IoT Architecture
Programming
IoT Protocal
Network & Security
Edge Devices
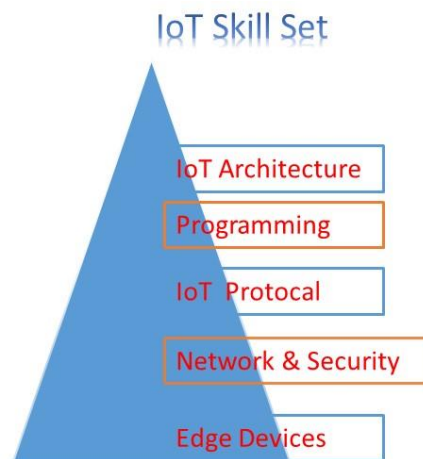
C. **Program-Specific Outcomes For Minor In Internet Of Things**

On completion of a Minor in Internet of Things, a student will be able to

PSO1: Design and develop secured IoT based embedded applications.

PSO2: Apply modern software and hardware tools to develop sustainable IoT applications to engage in lifelong learning and adapt in multi-disciplinary environment

PS03: Acquire IoT Application for environmental awareness

D. **Intake: Minimum 15**

E. **Eligibility criteria:** Students enrolled in Computer Science & Engg, Information Technology, Civil Engg, Mechanical Engg, Electrical Engg, Instrumentation Engg are eligible. The allotment of minor degree programme will be as per the policy of the Institute.

F. **Structure of the MDM course:**

E&Tc Department offer Mutidisplinary Minor Basket , Track-1 (Internet of Things)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	ET1315	Introduction to Internet of Things	3			3	15	15	10	60			100	3
MM2	ET1415	IoT Architecture & Protocols	3			3	15	15	10	60			100	3
MM3	ET1515	Programming with Arduino and Raspberry-Pi	3			3	15	15	10	60			100	3
MM4	ET1615	Industrial Internet of Things	3			3	15	15	10	60			100	3
MM5	ET1715	Project			4	4					25	25	50	2
Total			**12**	**0**	**4**	**16**	**60**	**60**	**40**	**240**	**25**	**25**	**450**	**14**

Course Code	ET1315								Course category		MM1
Course Name	INTRODUCTION TO INTERNET OF THINGS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	15	15	10	60	2.30 Hrs.	--	--	100	03

Course Objectives:

1. Describe what IoT is and how it works today
2. Recognize the factors that contributed to the emergence of IoT
3. Describe IoT Protocol
4. Recognize IoT cloud service providers
5. Define the infrastructure for supporting IoT deployments

Course Content:

Introduction to IoT: Architectural overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology, Fundamentals-Devices and gateways, Data management, Business processes in IoT, Role of cloud in IoT

Elements of IoT: Hardware components computing (Arduino, Raspberry Pi), communication, Sensing, Actuation, I/O interfaces Software Components- Programming APIs (Using python/Arduino) for communication protocols-MQTT, Zigbee, Bluetooth, CoAP, UDP, TCP.

Sensing and Actuation: Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT

IoT Application Development: Solution frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices

Text Book:

 Vijay Midisetti, Arshdeep Bahgha " Internet of Things : Hands on approach", University Press

Reference Books:

Raj Kamal ," Internet of things: Architecture Design", Tata McGraw-Hill.
Useful Links:

Introduction to IoT and Embedded Systems Course web link: https://www.coursera.org/learn/iot

Sensors and Actuators Course web link: https://nptel.ac.in/courses/108/108/108108147

Course Outcomes:

ET1315.1: Understand predecessor of IoT technology and emergence of Internet of Things.
ET1315.2: Understand the architecture for Internet of Things.
ET1315.3: Learn about computing elements in IoT devices.
ET1315.4: Develop IoT end devices with sensors, actuators, and microcontrollers
ET1315.5: Understand IoT cloud process

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1315.1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EE1315.2	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
EE1315.3	1	1	1	0	0	0	1	0	0	0	0	0	3	2	1
EE1315.4	0	1	1	0	0	0	0	0	2	0	0	0	2	2	0
EE1315.5	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0

0 - Not correlated 1 - Weakly Correlated   2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1415							Course category				MM2
Course Name	**IOT ARCHITECTURE & PROTOCOLS**											
Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2.30 Hrs.	--	--	100	03

Course Objectives:

1. Assess the genesis and impact of IoT applications, architectures in real world.
2. Illustrate diverse methods of deploying smart objects and connect them to network.
3. Compare different Application protocols for IoT.
4. Infer the role of Security in IoT.
5. Understand the role of IoT in various domains of Industry

Course Content:

IoT-An Architectural Overview: Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology

IoT Architecture-State of the Art Introduction, State of the art, Reference Model and Architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Real-World Design: Constraints- Introduction, Technical Design constraints Data management, Business processes in IoT,Bluetooth Low Energy, Zigbee Smart Energy, Wireless HART

Transport & Session Layer Protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) Session Layer-HTTP.

Service Layer Protocols & Security: Service Layer -oneM2M, ETSI M2M, OMA, BBF Security in IoT Protocols MAC 802.15.4

Text Books:
Jan Holler, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence

Reference Books:

Peter Waher "Learning of Internet of Things " Packt Publications,2006.

Useful Links:

Design of Internet of Things, Course web link: https://onlinecourses.nptel.ac.in/noc21_ee85/

Course Outcomes:

ET1415.1: Understand Basics of IoT Architectures.
ET1415.2: Understand IoT Protocols
ET1415.3: Understand Programming the IoT applications using Microcontrollers.
ET1415.4: Interpret IoT Technologies in real world design.
ET1415.5: Analyse IoT security layer protocols and security

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1415.1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EE1415.2	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
EE1415.3	1	1	1	0	0	0	1	0	0	0	0	0	3	2	0
EE1415.4	0	1	1	0	0	0	0	0	2	0	0	0	2	2	1
EE1415.5	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0

0 - Not correlated   1 - Weakly Correlated   2 - Moderately Correlated   3 - Strongly Correlated

Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in Electronics & Telecommunication Engineering

(In light of NEP 2020)

(NEP_Version II)

Offered By

Department of Electronics & Telecommunication Engineering

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

This minor program covers the most current theories and practices used in Electronics and Communication Engineering. The program provides a valuable adjunct credential to engineering students pursuing their major degree in various fields. Engineering students from any branch may choose from a considerable variety of complementary courses under the categories of technical and complementary studies offered by Electronics and Communication Engineering Department. This minor program is rigorous enough to serve as a introductory credential for students subsequently electing to pursue advanced studies in Electronics and Communication Engineering.

B. Program-Specific Outcomes For Minor In Internet Of Things

On completion of a Minor in Internet of Things, a student will be able to

PSO1: Design and develop secured Digital circuit applications.

PSO2: Apply modern software and hardware tools to develop sustainable Electronics applications to engage in lifelong learning and adapt in multi-disciplinary environment

PS03: Acquire embedded system Application for environmental awareness

C.   Intake: Minimum 15

D.   Eligibility criteria:

Students enrolled in Computer Science & Engg, Information Technology, Civil Engg,, Mechanical Engg, Electrical Engg, Instrumentation Engg are eligible. The allotment of minor degree programme will be as per the policy of the Institute.

E. Structure of the MDM course:

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme						Total	Credits
							Theory				Practical			
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	ET1316	Digital Circuits	3			3	15	15	10	60			100	3
MM2	ET1416	Communication Engineering	3			3	15	15	10	60			100	3
MM3	ET1516	Microprocessor & Embedded System	3			3	15	15	10	60			100	3
MM4	ET1616	Wireless Communication	3			3	15	15	10	60			100	3
MM5	ET1716	Project			4	4					25	25	50	2
Total			**12**	**0**	**4**	**16**	**60**	**60**	**40**	**240**	**25**	**25**	**450**	**14**

E&Tc Department offer Mutidisplinary Minor Basket , Track-2 (Electronics & Telecommunication Engg)

F. Detailed Syllabus:

Course Code	ET1316								Course category		MM1
Course Name	**DIGITAL CIRCUITS**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	--	03

Course Objectives:
1. To acquire the basic knowledge of digital logic circuit components
2. To implement minimization techniques and Boolean algebra for circuit minimization
3. To understand, analyze and design combinational logic circuits using gates and MSIs
4. To study various components and design sequential circuits and study semiconductor Memories

Number system and codes: Positional number system like binary, Decimal, Hexadecimal and Octal, conversions and arithmetic. Arithmetic using rth complements, Signed number representation and arithmetic, Codes: BCD, Gray, ASCII, etc and error detection codes.

Boolean algebra: Boolean algebra, Logic gates – basic (and, OR, NO), derived (Ex-OR,EX NOR) and universal (NAND, NOR), theorems and properties of Boolean algebra, DeMorgan's theorem, canonical and standard SOP and POS forms,

Logic functions Minimization: simplification and synthesis of Boolean functions using gates, Boolean theorems, K-Map, Don't care condition (up to four variables) and Implementation of Boolean expressions.

Combinational logic Circuit realization – realization of adders, Subtractor, BCD adder, ripple carry look ahead adders, comparator, parity generator, encoders, decoders, multiplexers, de-multiplexers, Realization of Boolean expressions- using decoders-and multiplexers.

Sequential circuits components – Introduction to sequential circuit. Latches, D, T, SR, JK flip flops, its triggering, inter-conversion, Shift registers: SISO, SIPO, PISO, PIPO, and Universal; Introduction to Counters.

Text Books:
1. Digital Principles & Logic Design by A. Saha N. Manna By Infinity Science Press LLC, 2007
2. Digital Design by Morris Mano, Pearson education, 2018

Reference Books:
1. T. L. Floyd "Digital Fundamentals", 11th ed., Pearson Education, 2018.
2. Wakerly J F, "Digital Design: Principles and Practices, Prentice-Hall", 5th Ed., 2018.
3. Roth C.H., "Fundamentals of Logic Design", Jaico Publishers. V Ed., 2009.

Course outcomes:
At the end of the course student will be able
ET1316.1   Optimize the digital circuits by applying the applying the Boolean algebra and other minimization techniques

ET1316.2	Examine and design the combinational circuits using gates and MSIs
ET1316.3	Realize the sequential circuits suing flip-flops counters and shift registers.
ET1316.4	Comparisons of logic families and implementation of gates using RTL, DTL and TTL
ET1316.5	Device logic circuits using SSIs and MSIs.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1316.1	2	0	0	0	0	0	0	0	0	0	0	0	2	1	0
ET1316.2	2	1	0	0	0	0	0	0	0	0	0	0	3	2	0
ET1316.3	2	2	1	1	1	1	0	0	0	0	0	0	3	2	0
ET1316.4	1	2	1	2	2	2	0	0	0	0	0	0	3	1	0
ET1316.5	3	3	1	2	3	1	0	0	1	1	0	0	3	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1416								Course category		MM2
Course Name	COMMUNICATION ENGINEERING										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

To make the student able
1. To introduce students with basics of communication system and its elements.
2. To describe various types of noise in communication systems.
3. To understand, analyze and explain the analog modulation schemes.
4. To identify the atmospheric and terrestrial effects on radio wave propagation.

Course Contents:

Introduction to Communications Systems: Communication system – Information, Transmitter, Channel, Noise, Receive; Modulation - Need for modulation; Electromagnetic spectrum and typical applications.

Noise: External noise – Atmospheric noise, Extraterrestrial noise, Industrial noise; Internal Noise – Thermal agitation noise, Shot noise; Noise Figure, Noise Temperature.

Amplitude Modulation: Frequency Spectrum of the AM Wave, Representation of AM, Power Relation in the AM wave, Demodulation: Envelop Detector.

Frequency Modulation: Theory of Frequency and Phase Modulation: Description of systems, Mathematical Representation of FM, Frequency Spectrum of the FM Wave, Phase Modulation, Intersystem Comparisons, Demodulation: Foster-Seeley Discriminator, Ratio Detector.

Propagation of Waves: Ground Waves, Sky-wave Propagation, Space Waves, Tropospheric Scatter Propagation, Extraterrestrial Communications.

Text Books:
1. Electronic Communication Systems, George Kennedy, Bernard Davis, McGraw Hill Publication, 5th edition, 2011.

Reference Books:
1. Communication System, S. Haykin, 5th edition, John Wiley and sons, 2009.
2. Electronic communications, R. Dennis and J. Coolen, 4th edition, Prentice Hall
3. Communication Electronics Principles and Application, "Frenzel", Tata McGraw Hill, 3rd Edition

Course Outcomes:

On completion of the course, students will be able to:

ET1416.1 understand and identify the fundamental concepts and various components of Analog Communication Systems.

ET1416.2 comprehend the effect of noise in communication systems.

ET1416.3 discuss the working principle of various analog modulation techniques.

ET1416.4 develop the ability to compare and contrast the strength and weaknesses of various analog modulation systems.

ET1416.5 identify the atmospheric and terrestrial effects on radio wave propagation.

CO – PO – PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
ET1416.1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET1416.2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET1416.3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET1416.4	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ET1416.5	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0

0 - Not correlated   1 - Weakly Correlated   2- Moderately Correlated 3- Strongly Correlated

Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in MACHINE LEARNING

(In light of NEP 2020)

(NEP_Version II)

Offered By

Information Technology Department

For students admitted in 2023-24 onwards

Government College of Engineering, Amravati
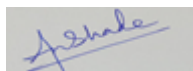
(An Autonomous Institute of Government of Maharashtra)

Near Kathora Naka, Amravati, Maharashtra

PIN 444604

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A. **Preamble:**

This multidisciplinary minor program covers specialized subjects pertaining to SE/ML domains. Those have lots of potential to cater to solution process of many complex problems. The MDM provides considerable leverage to students to develop a modern outlook for student's by getting an opportunity to experience the latest subjects of IT field.

B. **Program-Specific Outcomes** for Minor in **Software Engineering and Machine Learning**

On completion of a Minor in SE/ML, a student will be able to

PSO1 To inculcate a technically proficient outlook to application part of various different domains of information Technology

PSO2 To develop understanding of real-life and real-world problems that can be solved using specialized domains of software engineering & machine learning

PSO3 To exhibit the knowledge of SE/ME to formulate solution process of complex technical and societal problems

C. **Intake:** Minimum 15 and maximum 60 students (to be discuss)

D. **Eligibility criteria:**

a. Students enrolled in Electronics and Telecommunication Engg., Civil Engg,, Mechanical Engg, Electrical Engg, Instrumentation Engg are eligible. The allotment of minor degree programme will be as per the policy of the Institute

E. **Structure of the MDM course: Track-1**

IT Department offer Multi-disciplinary Minor Basket, Track-1 (Machine Learning)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme						Total	Credits
							Theory				Practical			
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	IT1315	Essential Math for Machine Learning	3	-	-	3	15	15	10	60	-	-	100	3
MM2	IT1415	Artificial Intelligence	3	-	-	3	15	15	10	60	-	-	100	3
MM3	IT1515	Machine Learning	3	-	-	3	15	15	10	60	-	-	100	3
MM4	IT1615	Deep Learning	3	-	-	3	15	15	10	60	-	-	100	3
MM5	IT1715	Minor Project	-	-	4	4	-	-	-	-	50	50	100	2
Total			**12**	**0**	**4**	**16**	**60**	**60**	**40**	**240**	**50**	**50**	**500**	**14**

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Multi-disciplinary Minor Basket, Track-1 (Machine Learning)

Course Code	IT1315							Course category		MM1
Course Name	ESSENTIAL MATHEMATICS FOR MACHINE LEARNING									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical	Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	30	10	60	02 hrs 30 min	--	--	100	03

Course Objectives

1. Introduce students to the vectors in machine learning ,vector space , Eigen values and Eigenvectors, Special Matrices .
2. Introduce students to Singular Value Decomposition, PCA, LDA.
3. Understand the Linear and Multiple Regression, Logistic Regression..
4. Understand the Gradient Descent and other optimization algorithms in machine
5. Apply and understand the concept of joint probability and covariance, SVM

Vectors in Machine Learning: Basics of Matrix Algebra, Vector Space, Subspace, Basis and Dimension,. Linear Transformations, Norms and Spaces, Orthogonal Complement and Projection Mapping, Eigen values and Eigenvectors, Special Matrices and Properties.

Spectral Decomposition: Singular Value Decomposition, Low Rank Approximations, Python Implementation of SVD and Low-rank Approximation., Principal Component Analysis, Python Implementation of PCA, Linear Discriminant Analysis, Python Implementation of LDA.

 Least Square Approximation and Minimum Normed Solution: Linear and Multiple Regression, Logistic Regression., Classification Metrics, Gram Schmidt Process, Polar Decomposition, Minimal Polynomial and Jordan Canonical Form, Some more Matrices Applications in Machine Leaning.

Numerical Optimization in Machine Learning: Gradient Descent and other optimization algorithms in machine learning., Optimization using Python, Review of Probability, Bayes theorem and random variable, Expectation and variance.

Discrete and continuous distribution functions: joint probability and covariance, Introduction to SVM, Error minimizing LPP., Lagrangian Multiplier method, concepts of duality, hard and soft margin classifier, SVM in Python.

Text Books
1. W. Cheney, Analysis for Applied Mathematics. New York: Springer Science + Business Medias, 2001.
2. S. Axler, Linear Algebra Done Right (Third Edition). Springer International Publishing, 2015.
3. J. Nocedal and S. J. Wright, Numerical Optimization. New York: Springer Science + Business Media, 2006.
4. J. S. Rosenthal, A First Look at Rigorous Probability Theory (Second Edition). Singapore: World Scientific Publishing, 2006.

Course Outcomes

Students will be able to:

IT1315.1   Use of vectors, Eigen values and Eigenvectors in machine learning

IT1315.2   Use of SVD, PCA and LDA to solve problems in machine learning

IT1315.3   Prepare the classification using Linear and Multiple Regression, Logistic Regression,

IT1315.4   Solve problems based on Gradient Descent, Bayes theorem

IT1315.5   Apply the concepts of SVM to various applications in machine learning

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1315.1	1	2	2	0	0	0	0	0	0	3	0	2	1	3	1
IT1315.2	2	2	3	0	0	0	0	0	0	0	0	1	2	3	1
IT1315.3	3	2	1	0	0	3	0	2	0	0	0	3	0	2	3
IT1315.4	1	3	3	0	0	0	1	0	0	1	0	2	2	0	2
IT1315.5	2	1	2	0	0	0	0	0	0	0	0	2	1	1	1

0-   Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlated

Course Code	IT1415							Course category		MM2
Course Name	ARTIFICIAL INTELLIGENCE									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory				Practical	Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	30	10	60	02 hrs 30 min	--	--	100	03

Course Objectives:

I.   To gain a historical perspective of AI and its foundations

II. To become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.

III. To investigate applications of AI techniques in intelligent agents, expert systems and other machine learning models.

Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents, Natural Language Possessing.

Knowledge Representation & Reasoning : Syntax and semantics for propositional logic, Syntax and semantics for first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Knowledge organization and manipulation: Preliminary concept, Examples of search problems, Uniformed and blind search. Informed search, Indexing and retrieval technique, integrating knowledge in memory.

Knowledge Acquisition: General concept in knowledge acquisition, learning by induction. Analogical and explanation-based learning: Analogical learning and reasoning, Explanation and learning.

Expert system: Expert system architectures: Introduction, Rules based system architecture, Knowledge acquisition and validation, Knowledge system building tools.

Text Books:

1. Artificial Intelligence, P.H. Winston, 2nd Edition Addison- Wesley Publication Company, 1984.

2. Introduction to Artificial Intelligence E. Charniac and D. McDermott, 2nd Edition, Addison Wesley Publishing Company, 2002.

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Reference Book:

1 Introduction to expert systems, Peter Jackson, 3rd Edition, Addison-Wesley Publishing Company, 1986.
2 Artificial Intelligence, E. Rich, K.K. Knight,2nd Edition, Tata McGraw Hill, New Delhi, 1991.
3 LISP-The language of Artificial Intelligence, F. Holtz, TAB Books Inc. 1985.
4 Principles of Artificial Intelligence & Expert Systems Development, D.W. Rolston, McGraw Hill, 1988.

Useful link:

https://nptel.ac.in/courses/106/105/106105077/

https://nptel.ac.in/courses/106/105/106105078/

Course Outcomes:

On completion of the course, students will be able to:

IT1415.1 Student will be able to demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

IT1415.2 Student will apply basic principles of AI in solutions that require problem solving, inference, perception.

IT1415.3 Student will apply basic principles of AI in knowledge representation, and learning.

IT1415.4 Students will able to demonstrate proficiency in applying scientific method to models of machine learning.

IT1415.5 Students will apply AI techniques to real-world problems to develop intelligent systems.

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1415.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IT1415.2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2
IT1415.3	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0
IT1415.4	0	0	3	3	0	0	0	0	0	0	0	0	0	0	1
IT1415.5	0	0	0	0	2	0	0	0	0	0	0	0	2	0	3

0- Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlated

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Course Code	IT1515							Course category		MM3
Course Name	MACHINE LEARNING									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical	Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	30	10	60	02 hrs 30 min	--	--	100	03

Course Objectives:

1 To understand the basic theory underlying machine learning

2 To be able to formulate machine learning problem corresponding to different applications.

3 To understand a range of machine learning algorithms along with their strength and weaknesses

4 To understand linear model methods

5 To Understand different types of learning methods.

Introduction to Machine Learning: Why Machine learning, Examples of Machine Learning Problems, Structure of Learning, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, Probabilistic Models.

Features: Feature types, Feature Construction and Transformation, Feature Selection.

Classification and Regression Classification: Binary Classification- Assessing Classification performance, Class probability Estimation Assessing class probability Estimates, Multiclass Classification.

Regression: Assessing performance of Regression- Error measures, Overfitting- Catalysts for Overfitting, Case study of Polynomial Regression.

Linear Models: Least Squares method, Multivariate Linear Regression, Regularized Regression, UsingLeast Square regression for Classification. Perceptron, Support Vector Machines, Soft Margin SVM.

Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm.

Tree Based Models: Decision Trees, Ranking and Probability estimation Trees, Regression trees, Clustering Trees. Probabilistic Models Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood, Probabilistic Models with Hidden variables: Estimation-Maximization Methods, Gaussian

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Mixtures, and Compression based Models.

Trends in Machine Learning: Model and Symbols- Bagging and Boosting, Multitask learning, Online learning and Sequence Prediction, Data Streams and Active Learning, Deep Learning, Reinforcement Learning.

Text Books:

1. Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge University Press, Edition 2012.

2. Introduction to Statistical Machine Learning with Applications in R, Hastie, Tibshirani, Friedman,Springer, 2nd Edition-2012.

Reference Books:

1. Pattern Recognition and Machine Learning, C. M. Bishop, Springer 1st Edition-2013.

2. Introduction to Machine Learning, Ethem Alpaydin, PHI 2nd Edition-2013.

3. Reinforcement and Systematic Machine Learning for Decision Making, Parag Kulkarni ,Wiley IEEE Press, Edition July 2012.

Course Outcomes:

On completion of the course:

IT1515.1   Students will be able to model the learning primitives.

IT1515.2   Students will be able to build the learning model.

IT1515.3   Implement the technique of classification methods.

IT1515.4   Implement the technique of tree based models.

IT1515.5   Student will be able to tackle real world problems in the domain of Data Mining, Information Retrieval, Computer vision, Linguistics and Bioinformatics.
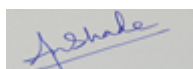
CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1515.1	2	2	0	0	3	0	0	0	0	0	0	0	2	3	3
IT1515.2	2	2	1	0	3	0	0	0	0	0	0	0	2	3	2
IT1515.3	2	3	3	2	3	2	0	0	0	0	0	0	2	3	3
IT1515.4	2	3	3	2	3	2	0	0	0	0	0	0	2	3	3
IT1515.5	2	3	3	2	3	2	0	0	0	0	0	0	2	3	3

0- Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlated

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Course Code	IT1615						Course category		MM4
Course Name	DEEP LEARNING								
Teaching Scheme				**Examination Scheme**					**Credits**
Th	Tu	Pr	Total	Theory				Practical	Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	30	10	60	02 hrs 30 min	--	--	100	03

Course Objectives

1. To understand the basics of neural networks
2. Comparing different deep learning models
3. To understand the Recurrent and Recursive nets in Deep Learning
4. To understand the basics of deep reinforcement learning models
5. To analyze Types of Networks

Foundations of Deep learning: What is machine learning and deep learning? History of deep learning, Advantage and challenges of deep learning. Learning representations from data , Understanding how deep learning works in three figures(input, hidden layer, output), Common Architectural Principles of Deep Network, Architecture Design, Applications of Deep learning, Hyperparameters : Learning Rate, Regularization, Momentum, Sparsity, Hidden Units, cost functions, error back propagation, Gradient-Based Learning, Implementing Gradient Descent, vanishing and Exploding gradient descent, Optimization algorithm(SGD, AdaGrad, RMSProp, adam).

Deep Neural Networks (DNNs): Introduction to Neural Networks :The Biological Neuron, The Perceptron(AND,OR,NOT,XOR), Deep forward network, Multilayer Feed-Forward Networks , Training Neural Networks :Backpropagation and Forward propagation Activation Functions :Linear ,Sigmoid, Tannh, Hard Tanh, Softmax, Rectified Linear, Loss Functions :Loss Function Notation , Loss Functions for Regression , Loss Functions for Classification, Loss Functions for Reconstruction.

Convolution Neural Network (CNN): Introduction, CNN architecture overview, The Basic Structure of a Convolutional Network- Padding, Strides, Typical Settings, the ReLU layer, Pooling, Fully Connected Layers, The Interleaving between Layers, Local Response Normalization, Training a Convolutional Network

Recurrent Neural Network (RNN): Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks,

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The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory

Deep Generative Models: Introduction to deep generative model, Boltzmann Machine, Deep Belief Networks, Generative adversarial network (GAN), discriminator network, generator network, types of GAN, Applications of GAN networks

Text Books
1. Goodfellow, I., Bengio, Y., Courville, A, "Deep Learning", MIT Press, 2016
2. Josh Patterson & Adam Gibson, "Deep Learning"
3. Charu Agarwal, "Neural Networks and deep learning"
4. Nikhil Buduma, "Fundamentals of Deep Learning", SPD
5. Francois chollet, "Deep Learning with Python"

e-Resources:
1. http://csis.pace.edu/ctappert/cs855-18fall/DeepLearningPractitionersApproach.pdf
2. https://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf

MOOC Courses:
1. Deep Learning- Part 1, IIT Madras: https://nptel.ac.in/courses/106106184
2. Deep Learning Specialization: https://www.coursera.org/specializations/deep-learning

Course Outcomes
Students will be able to:
IT1615.1   Understand the basics of Deep Learning and apply the tools to implement deep learning applications
IT1615.2   Evaluate the performance of deep learning models
IT1615.3   Implement the technique of Convolution neural network (CNN)
IT1615.4   Solve the language translation problem by Recurrent neural network (RNN)
IT1615.5   Construct new data by deep generative models

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1615.1	2	3	1	0	0	0	0	0	0	0	0	1	2	3	1
IT1615.2	3	3	3	0	0	0	0	0	0	0	0	1	3	3	1
IT1615.3	3	3	3	0	0	0	0	0	0	0	0	1	3	3	1
IT1615.4	3	3	3	0	0	0	0	0	0	0	0	1	3	3	1
IT1615.5	1	3	2	0	0	0	0	0	0	0	0	1	3	3	1

0-Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlated

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Course Code	IT1715								Course category		MM5
Course Name	MINOR PROJECT										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE	
--	--	04	04	--	--	--	--	--	50	50	100	02

Course Objectives

1 To offer students a glimpse into real world problems and challenges that need IT based solutions
2 To enable students to create very precise specifications of the IT solution to be designed and use all concepts of IT in creating a solution for a problem.
3 To introduce students to the vast array of literature available of the various research challenges in the field of IT and create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
4 To enable students to and improve the team building, communication and management skills of the students.

Minor Project Each batch consists of maximum 2-3 students.

Students can refer following domain list for developing minor project.

1. Web server, DNS Server, Proxy Server, Mail Server.

2. Database connectivity.

3. Cyber Security

4. Client-server Architecture.

5. Networking.

6. Data Mining and Data Ware housing.

7. Data Science.

8. Machine Learning, Deep Learning.

9. Internet of Things.

10. Cloud Computing.

11. Artificial Intelligence.

12. Block chain.

13. Network Security.

14. Cryptocurrency

15. Big Data Analytics.

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Course Outcomes:-

Students will be able to:

IT1715.1 Discover potential research areas in the field of IT

IT1715.2 Conduct a survey of several available literature in the preferred field of study and formulate and propose a plan for creating a solution for the research plan identified

IT1715.3 Compare and contrast the several existing solutions for research challenge and demonstrate an ability to work in teams and manage the conduct of the research study.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1715.1	2	3	1	0	0	0	0	0	0	0	0	1	2	3	1
IT1715.2	3	3	3	0	0	0	0	0	0	0	0	1	3	3	1
IT1715.3	3	3	3	0	0	0	0	0	0	0	0	1	3	3	1

0- Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlated

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Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in SOFTWARE ENGINEERING

(In light of NEP 2020)

(NEP_Version II)

Offered By

Information Technology Department

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Structure of the MDM course: Track-2

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme						Total	Credits
							Theory				Practical			
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	IT1316	Data Structure & Algorithms	3			3	15	15	10	60	-	-	100	3
MM2	IT1416	Software Engineering	3			3	15	15	10	60	-	-	100	3
MM3	IT1516	Object Oriented Design & Programming	3			3	15	15	10	60	--	-	100	3
MM4	IT1616	Software Testing	3			3	15	15	10	60	-	-	100	3
MM5	IT1716	Minor Project	-	-	4	4	-	-	-		50	50	100	2
Total			12	0	4	16	60	60	40	240	50	50	500	14

IT Department offer Multi-disciplinary Minor Basket, Track- 2 (Software Engineering)

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F. Multi-disciplinary Minor Basket, Track- 2 (Software Engineering)

Course Code	IT1316							Course category		MM1
Course Name	DATA STRUCTURES AND ALGORITHMS									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	02 hrs 30 min	--	--	100	03

Course Objectives
1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly , Circular linked list: operations on it.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree,Tree operations on each of the trees .Applications of Binary Trees.

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Text books

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1. Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

2. Richard Gilberg and Behrouz Forouzan, "Data structures A Pseudo code Approach with C", 2nd edition, 2005,Cengage Learning.

Reference books

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company

2. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

3. "Data structures with C", Seymour Lipschutz, 1st Edition, 2017, SchaumSeries,TataMacGraw Hill

Useful link:

http://nptel.ac.in/courses/106106130/, IIT Madras

http://nptel.ac.in/courses/106103069/, IIT Guwahati

http://nptel.ac.in/courses/106106127/, Prof. Shankar Balachandran, IIT Madras

Course outcomes

Student will be able to

IT1316.1 Analyse the time and computation complexity and justify the correctness of an algorithm. Implement, use and analyse various searching techniques. (Linear Search and Binary Search)

IT1316.2 Design and analyse the algorithm for given problem using of Stacks, Queues

IT1316.3 Learn various types of linked list and related algorithms, complexity analysis and choose appropriate linked list for given application.

IT1316.4 Apply Non-Linear Data Structures Graph, Trees -search and traversal algorithms and determine the time and computation complexity

IT1316.5 Discuss and Use different Sorting and Hashing Algorithms and compare their performances in term of Space and Time complexity.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1316.1	3	1	2	0	1	0	0	0	0	1	1	1	1	3	2
IT1316.2	3	1	1	0	2	0	0	0	0	1	1	1	1	3	2
IT1316.3	3	1	1	0	2	0	0	0	0	1	1	1	1	3	2
IT1316.4	3	1	1	0	2	0	0	0	0	1	1	1	1	3	2
IT1316.5	3	1	1	0	1	0	0	0	0	1	1	1	1	3	2

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Course Code	IT1416			Course category					MM2	
Course Name	SOFTWARE ENGINEERING									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory				Practical	Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	30	10	60	02 hrs 30 min	--	--	100	03

COURSE OBJECTIVES

1   To familiarize students with the principles of software engineering (SE) in general.
2   Understand efficient techniques for managing systems development lifecycle.
3   To imbibe a correct sense of SE principles and role during development processes.
4   To inculcate a sense of team-work and team-leadership in a software development team.
5   To gain a better understanding of software development processes in general and to learn different techniques and methodologies for developing large software systems

Introduction: Software Characteristics, Software Engineering: A Layered Technology, Software Process Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Agile Process Model

Software Engineering Principles and Practice: Communication Practices, Planning Practices, Requirements Engineering

Software Quality Management and Software Testing: Quality concepts, Evolution of Quality Management, Quality assurance, Software Reviews, Testing Fundamentals

Software Project Management: Introduction to Software Project Management, Project Planning, Project Scheduling, Software Teams and Role of Leadership

Agile Software Development: Introduction to Agile development, Agile Processes, Extreme Programming, Dynamic Software Development Method

Text Books:
1. Software Engineering: A Practitioner's Approach by Roger Pressman (Tata Mc. Hill)
2. Software Engineering (Ninth Edition) by Ian Summerville (Pearson Education)
3. An Integrated Approach to Software Engineering, by Pankaj Jalote (Springer/Narosa)
4. Fundamentals of Software Engineering, by Rajib Mall, (Prentice Hall India)

Reference Books:
1. Schaum's Outline of Software Engineering by David Gustafson (Tata Mc. Hill)
2. Software Project Management by Sanjay Mohapatra (Cengage Learning India Pvt. Ltd.)

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Course Outcomes

IT1416.1 Able to interpret a general understanding of software engineering from a professional and wider viewpoint.

IT1416.2 Apply methodically the skills learned during the course to actual circumstances of problem understanding and software development.

IT1416.3 Understand the processes of software development as an effective role player.

IT1416.4 Able to practice good communication in software development activities.

IT1416.5 Understand the technical and ethical obligation of developing contemporary software and engaging in lifelong learning.
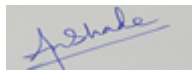
CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1416.1	3	2	0	0	2	0	0	0	0	0	0	0	0	2	1
IT1416.2	0	2	3	0	0	0	0	0	0	0	0	0	1	2	1
IT1416.3	0	1	1	2	2	0	0	0	0	0	0	0	0	2	2
IT1416.4	1	0	0	2	0	0	0	0	0	0	0	0	2	2	3
IT1416.5	2	0	0	0	0	3	--	1	2	--	2	3	2	2	2

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Course Code	IT1516						Course category			MM3
Course Name	OBJECT ORIENTED ANALYSIS AND DESIGN									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical	Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE	
03	--	--	03	30	10	60	02 hrs 30 min	--	--	100	03

COURSE OBJECTIVES
1. To describe the activities in the different phases of the object-oriented development life cycle.
2. To State the advantages of object-oriented modeling v
3. Model a real-world application by using a UML classdiagram.
4. Recognize when to use generalization, aggregation, and composition relationships.

Object Oriented concepts: Objects and classes, abstraction, encapsulation, generalization, polymorphism and inheritance, polymorphism, link and association, Need for object oriented approach.

Object Modeling Technique : System design life cycle, object oriented S/W development process model, Object Oriented Analysis, object model, function model, relationship among models, object diagrams, state diagrams, data flow diagrams.

Unified Modeling Language : Class diagram, sequence diagram, Use case diagram, Collaboration diagram, state chart diagram, Activity diagram, component diagram, deployment diagram.

Translation of Object Oriented design into implementation: Programming style, Documentation, characterization of object oriented languages, Comparison of object oriented language like C++, JAVA.

Introduction to Design Pattern: Designing objects with responsibilities .Creator, Information expert, Low Coupling, High Cohesion, Controller Design Patterns ,creational, factory method , structural, Bridge, Adapter ,behavioral, Strategy, observer, Applying GoF design patterns.

TEXT BOOKS
1 Michael Blaha and James Rumbaugh, "Object-Oriented Modeling and Design with UML", 2nd Edition, Pearson Education,2005

REFERENCE BOOK
1 Grady Booch, Michael W. Engel, Kelli A. Houston, Robert A. Maksimchuk, Bobbi J.

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Young, Jim Conallen, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 2009

2 Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides, "Design Patterns: Elements of Reusable Object-oriented Software", Pearson Education India, 2004.

COURSE OUTCOMES

At the end of the course, the students will be able to

IT1516.1	Define the fundamentals of OO approach.
IT1516.2	Design OO Application using design patterns.
IT1516.3	Solve real world problems by applying OOAD principle.
IT1516.4	Acquire expertise in Java Programming

CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1516.1	3	2	0	0	3	0	0	0	0	0	0	0	0	2	1
IT1516. 2	2	2	0	0	3	0	0	0	0	0	0	0	1	2	1
IT1516.3	2	2	0	2	3	0	0	0	0	0	0	0	0	2	2
IT1516.4	2	2	2	2	3	0	0	0	0	0	0	0	2	2	3

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Course Code	IT1616			Course category					MM4
Course Name	SOFTWARE TESTING								

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	02 hrs 30 min	--	--	100	03

Course Objective:
1. Study fundamental concepts of software testing.
2. To understand application in various scenarios with the help different testing strategies, methods and tool
3. To identify and eliminate defects or bugs within the application.
4. To identify defects that can range from minor glitches to critical errors that may lead to system crashes or incorrect data processing.

Introduction: Software Testing, Importance of testing, Roles and Responsibilities, Testing Principles, Attributes of Good Test, V-Model, Test Case Generation , SDLC Vs STLC, Software Testing Life Cycle-in detail.

Types of Testing: Testing Strategies: Unit Testing, Integration Testing, System Testing, Smoke, Regression Testing, Acceptance Testing. Clean Room Software Engineering. Functional/Non- Functional Testing. Testing Tools, Categorization of testing methods:

Manual Testing, Automation Testing and Automated Testing Vs. Manual Testing.

Non Functional Testing: Performance Test, Memory Test , Scalability Test, Compatibility Test, Security Test, Cookies Test, Session Test, Recovery Test, Installation Test, Ad-hoc Test, Risk Based Test,

Compliance Test. McCall's Quality Factors, FURPS.

Software Testing Methodologies: Validation & Verification, White/Glass Box Testing, Black Box Testing, Grey Box Testing, Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing, Boundary Value Analysis, Equivalence Class Partition, State Based Testing, Cause Effective Graph, Decision Table, Use Case Testing, Exploratory testing

and Testing Metrics, Testing GUI

Software Testing Life Cycle: Requirements Analysis/Design, Traceability Matrix, Test Planning, Objective, Scope of Testing, Schedule, Approach, Roles & Responsibilities, Assumptions, Risks & Mitigations,

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Entry & Exit Criteria, Test Automation, Deliverables.

Test Cases Design: Write Test cases, Review Test cases, Test Cases Template, Types of Test Cases, Difference between Test Scenarios and

Test Cases. Test Environment setup, Understand the SRS, Hardware and software requirements, Test Data.

Test Execution: Execute test cases, Error/Defect Detecting and Reporting, DRE(Defect Removal Efficiency), Object ,Types of Bugs , Art of Debugging,. Debugging Approaches, Reporting the Bugs, Severity and

priority, Test Closure, Criteria for test closure, Test summary report.

Test Metrics: Test Measurements, Test Metrics, Metric Life Cycle, Types of Manual Test Metrics.

Course Outcomes: After completion of this course, student will be able to

IT1616.1   Understand importance of testing techniques in software quality management and assurance (Understand)

IT1616.2   Identify various types of software risks and its impact on different software application. (Analyze)

IT1616.3   Create test case scenarios for different application softwares using various testing techniques. (Create)

IT1616.4   Apply different testing methodologies used in industries for software testing. (Apply)
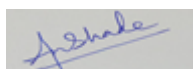
CO-PO-PSO Mapping:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1616.1	1	2	0	0	3	0	0	0	0	0	0	0	0	2	1
IT1616.2	2	3	0	0	2	0	3	0	0	0	0	1	1	2	1
IT1616.3	3	2	0	2	3	0	0	0	2	0	0	0	0	2	2
IT1616.4	2	2	2	2	3	0	0	0	0	0	0	0	2	2	3

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Course Code	IT1716								Course category		MM5
Course Name	MINOR PROJECT										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
--	--	04	04	--	--	--	--	--	50	50	100	02

Course Objectives

1 To offer students a glimpse into real world problems and challenges that need IT based solutions
2 To enable students to create very precise specifications of the IT solution to be designed and use all concepts of IT in creating a solution for a problem.
3 To introduce students to the vast array of literature available of the various research challenges in the field of IT and create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
4 To enable students to and improve the team building, communication and management skills of the students.

Minor Project Each batch consists of maximum 2-3 students.

Students can refer following domain list for developing minor project.

1. Web server, DNS Server, Proxy Server, Mail Server.

2. Database connectivity.

3. Cyber Security

4. Client-server Architecture.

5. Software testing

6. Data Mining and Data Ware housing.

7. Data Science.

8. Machine Learning, Deep Learning.

9. Internet of Things.

10. Cloud Computing.

11. Artificial Intelligence.

12. Block chain.

13. Network Security.

14. Cryptocurrency

15. Big Data Analytics.

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Course Outcomes:-

Students will be able to:

IT1716.1 Discover potential research areas in the field of IT

IT1716.2 Conduct a survey of several available literature in the preferred field of study and formulate and propose a plan for creating a solution for the research plan identified

IT1716.3 Compare and contrast the several existing solutions for research challenge and demonstrate an ability to work in teams and manage the conduct of the research study.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT1716.1	2	3	1	0	0	0	0	0	0	0	0	1	2	3	1
IT1716.2	3	3	3	0	0	0	0	0	0	0	0	1	3	3	1
IT1716.3	3	3	3	0	0	0	0	0	0	0	0	1	3	3	1

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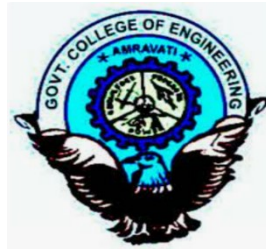# Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in Instrumentation & Control

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF INSTRUMENTATION ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

The Instrumentation engineering minor is tailored to students who want to understand the fundamentals of Instrumentation engineering other than courses covered in engineering sciences. The students will develop abilities in measurement using transducers, control system concepts and recent automation technology .The students will be able to study the concepts and implementation of the instrumentation measurement and control by using the modern tools .

The students can combine the skills and technological expertise of this minor with a major in technology of aligned branch to prepare for a wide variety of opportunities in industrial fields and in demand careers.

B. Structure of the MDM course:

Instrumentation Engineering Department offer Multidisciplinary Minor Basket , Track-1 (Instrumentation and Control)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Total	Credits
							Theory				Practical			
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	IN1315	Industrial Measurement I	3			3	15	15	10	60			100	3
MM2	IN1415	Industrial Measurement 2	3			3	15	15	10	60			100	3
MM3	IN1515	Control system Engineering	3			3	15	15	10	60			100	3
MM4	IN1615	Industrial Automation	3			3	15	15	10	60			100	3
MM5	IN1715	Programming for PLC,DCS & SCADA	1		2	3	15	15	10	60			100	2
Total			**13**	**0**	**2**	**15**	**75**	**75**	**50**	**300**	**0**	**0**	**500**	**14**

C. **Eligibility criteria:** Students enrolled in B. Tech program other than Instrumentation Engineering are eligible. The allotment of minor degree Programme will be as per the policy of the Institute.

D. **Intake :** Minimum 15

SEMESTER – III

Course Code	IN1315			Course category		MM1
Course Name	Industrial Measurement-I					
Teaching Scheme				Examination Scheme		Credits
Th	Tu	Pr	Total	Theory	Practical	Total	

Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

To make the students aware and understand:

1. To provide the knowledge of fundamentals and types of all the sensors and Transducers
2. To understand the sensors and transducers concept and its applications in the process measurement
3. To describe, draw, classify and produced sketches, drawings to explain working principles of various sensors and transducers.
4. To select transducers/sensors for specific applications

Course Contents:

Temperature Measurement :- Temperature scales, classification of temperature sensors, standards, working principle, types, materials, Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistor), radiation sensors (pyrometers), photo electric radiation thermometers, IC temperature transducers

Pressure measurement: Definition, pressure scale, standards, working principle, types, materials, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, capacitive (delta cell), Pressure Transmitter definition, two wire and four wire transmitters, I/P and P/I converters.

Flow Measurement: Essential principles of fluid mechanics and properties of fluid, types of fluid flow, continuity equation, Bernoulli's equation, Reynolds"s number, laminar and turbulent flows, pascal's law, Selection criteria of flow sensors. Head Type Flow Meter:

Orifice, venturi, nozzle, pitot tube, Variable Area Type Flow Meter: Rota-meter, Open Channel: Turbine, Target, Electro Magnetic, Ultrasonic, Vortex Shedding, Mass Flow Meter: Coriolis, Thermal & solid flow meters

Level measurement: Basic level measurement principals, selection criteria for level sensors. float, Bubblers, displacer (torque tube unit), capacitive, conductivity, Differential level sensor, float level sensor, Laser level sensor, microwave level switch, radar Laser (contact, non-contact – TDR / PDS), optical level devices, radiation level sensor, , Ultrasonic level Detector

Humidity, pH and Viscosity Measurement: Humidity terms - dry & wet bulb psychrometers - hot wire electrode type hygrometer, electrolytic hygrometer, Dewpoint hygrometer, Capacitive hygrometer, pH measurement : Nearnst equation, construction & working of pH sensor, temperature compensation, pH measurement electrodes, maintenance and applications, Viscosity terms, saybolt viscometer, rotometer type viscometer

Text Books:
1. Arun Ghosh, Introduction to Measurements and Instrumentation, PHI Learning Pvt. Ltd.
2. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:
1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, Eleventh ed., 2000.
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. E.O. Doebelin, "Measurement Systems", McGraw Hill.
5. Bentley J. P., Principles of measurement systems, Third Edition, Pearson education Asia pvt.ltd, 2000
6. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
7. S. P. Venkateshan," Mechanical Measurements", Willy publication second edition. 2015

Useful Link:

1. **Course name: Industrial Measurement-I course**
   https://onlinecourses.nptel.ac.in/noc23_ee105/preview Name of Course offered by NPTEL: Transducers for Instrumentation By Prof. Ankur Gupta, IIT Delhi.

Course Outcomes:

On completion of the course, students will be able to:

INU1315.1   : Identification of sensors and transducer (Primary and secondary).

INU1315.2   : Demonstrate the working principles of various sensors and transducers

INU1315.3   : Evaluate and classify various sensors and transducers

INU1315.4   : Interpret the characteristics of the transducers/sensors

INU1315.5   : Demonstrate working principle of chemical sensors used in process industry

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1315.1	1	1	--	--	--	--	--	--	--	1	--	--	2	--	--
IN1315.2	1	1	1	2	--	--	--	--	--	--	--	--	1	--	--
IN1315.3	1	--	1	2	--	--	--	1	--	--	--	--	2	--	1
IN1315.4	1	--	1	--	--	--	1	--	--	--	1	--	2	1	--
IN1315.5	1	1	1	--	2	--	--	--	--	--	--	--	2	--	1
Average	1	1	1	2	2	0	1	1	0	1	1	0	1.8	1	1

0 - Not correlated   1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

SEMESTER – IV

Course Code	IN1415								Course category		MM2
Course Name	INDUSTRIAL MEASUREMENT-II										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objectives :

To make the students aware and understand:

1. To understand how physical quantities are measured and how they are converted to electrical or other forms
2. To have an adequate knowledge of change in resistance in various transducers
3. To develop the knowledge of inductance and capacitance transducers.
4. To teach the design of signal conditioning circuits

Course Contents:

Displacement Measurement: Resistive (Potentiometer and Linear), Inductive(LVDT and Eddy current type) and capacitive(Capacitance principles Concept & variable capacitance due to change in dielectric media, area of the plate, distance between the plates) Displacement Sensors, Piezoelectric Transducers and Sensors, Ultrasonic Displacement Sensors, Optical Encoder Displacement Sensors, Hall effect transducers.

Velocity and speed measurement: Doppler Velocimeter, Doppler effect, Ultrasonic Doppler velocity meter, time of flight velocimeter Mechanical tachometer: centrifugal force tachometer, vibrating tachometer , Electrical Tachometer: Drag Cup Tachometer, AC-DC Tachogenerators, Photoelectric tachometer, Photoelectric tachometer, Magnetic pickups, stroboscope

Vibration and acceleration measurement: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Absolute Accelerometer, Relative Accelerometer Piezoelectric accelerometers , Piezoresistive Accelerometers

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer.

Design of signal conditioning circuit : Input Characteristics, Amplifiers, operational amplifiers Voltage Follower, various Converters, Sensor Connections, use of bridges, voltage generator, oscillators, Signal Conditioning for Resistive Sensors, Reactance Variation and Electromagnetic Sensors, Signal Conditioning for Reactance Variation Sensors

Advances in sensors technology: Introduction to Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors.

Text Books:
1. S. P. Venkateshan," Mechanical Measurements", Willy publication second edition. 2015
2. Ramon Palla¡ S-areny, John g. Webster, "sensors and signalconditioning" second edition, john wiley & sons, inc

Reference Books:
1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, Eleventh ed., 2000.
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. E.O. Doebelin, "Measurement Systems", McGraw Hill.

Useful Link:

1. **Course name: Industrial Measurement -II course**
   https://onlinecourses.nptel.ac.in/noc23_ee105/preview Name of Course offered by NPTEL: Transducers for Instrumentation By Prof. Ankur Gupta, IIT Delhi.

Course Outcomes:
Upon Completion of this course, students will able to

INU1415.1   Interpret the concepts of signal conditioning circuits for resistive sensors
INU1415.2   To demonstrate working of various resistive, inductive and capacitive transducers
INU1415.3   Illustrate the working principle of velocity and acceleration transducers
INU1415.4   Apply the adequate knowledge of force transducers
INU1415.5   Provide exposure new trends in smart sensors.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1415.1	1	1	--	--	--	--	--	--	--	1	--	--	2	--	--
IN1415.2	1	1	1	2	--	--	--	--	--	--	--	--	1	--	--
IN1415.3	1	--	1	2	--	--	--	1	--	--	--	--	2	--	1
IN1415.4	1	--	1	--	--	--	1	--	--	--	1	--	2	1	--
IN1415.5	1	1	1	--	2	--	--	--	--	--	--	--	2	--	1
Average	1	1	1	2	2	0	1	1	0	1	1	0	1.8	1	1

0 - Not correlated   1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	IN 1515					**Course category**			MM3	
Course Name	**CONTROL SYSTEM ENGINEERING**									

Teaching Scheme				**Examination Scheme**								**Credits**
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objectives:

To make the students aware and
1. To impart the basic knowledge of fundamentals of control systems
2. To impart the knowledge of the mathematical model for different physical systems
3. To impart the knowledge of transfer function analysis for control system by BDR,SFG techniques
4. To impart the knowledge of identifying performance characteristics of first and second-order systems for different standard inputs
5. To impart the knowledge of testing the stability of control system by RH Crietiron, time domain and frequency domain techniques, state space representation of control system

Course Contents:

Fundamentals of control systems: Introduction to need for automation and automatic control, Basic Components of a Control System, Concept of open loop and closed loop Systems, Examples of control system, Effects of Feedback, Review of Laplace and inverse Laplace transform, Transfer functions.

Mathematical modeling: Mathematical modeling of: electrical systems, mechanical systems, electro-mechanical systems, Electrical analogues of dynamical systems, Block diagrams, Block diagram reductions, Signal flow graph, Mason's gain formula, Application of gain formula to block diagrams.

Time response analysis: Time response of system, Standard test signals, Analysis of first order and second order systems, Time response specifications, Steady state errors and error constants.

Stability analysis: Stability of open loop and closed loop systems, Routh-Hurwitz criterion, Stability and Performance analysis, Root locus techniques, Root locus construction rules, Sketching of Root Locus.

Frequency response analysis: Frequency domain specifications, Correlation between time and frequency responses, Bode plots, Phase margin and Gain margin, Introduction to polar plots

Introduction to State Space : State Space Representation of the control system , State Variables representation ,conversion of transfer function to state variable model

,Representation of state equation .

Text Books:
1. Norman Nise, Control System Engineering, Wiley International, sixth edition, 2011.
2. Nagrath and Gopal, Control System Engineering-, New Age International Publication, fifth edition, 2003.

Reference Books:
1. C.H. Houpis, S.N. Sheldon, Linear Control System Analysis and Design with MATLAB, CRC Press; 6 edition.
2. G. Goodwin, S.Graebe, Mario Salgado, Control System Design, Pearson Education, edition.
3. G. Franklin, J.Powell, A. Naeini, Feedback Control of Dynamic Systems, Pearson, 6th edition.
4. K. Ogata, Modern Control Engineering, Prentice Hall Publications, fifth edition.
5. Dorf and Bishop, Modern Control Systems:, Addison Wesley, LPE, 9th Edition.
6. B. C. Kuo, Automatic control system, Prentice Hall of India, 7th Edition, 1995

Course Outcomes:

After completion of the course students will be able to

INU1515.1	Classify open and closed control systems with their characteristics
INU1515.2	Develop the mathematical model of electrical, mechanical system and Derive the transfer function of given system by using BDR,SFG techniques
INU1515.3	Obtain the response of first & second-order systems
INU1515.4	Determine the stability of control system by Time & frequency domain
INU1515.5	Represent the control system in State space representation

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1515.1	3	--	--	--	--	--	--	--	--	--	--	--	3	--	--
IN1515.2	3	2	--	--	--	--	--	--	--	--	--	--	3	--	--
IN1515.3	3	--	--	--	--	--	--	--	--	2	--	--	3	--	--
IN1515.4	3	--	--	--	--	--	--	--	--	2	--	--	3	--	--
IN1515.5	3	--	--	--	--	--	--	--	--	2	--	--	3	--	--
Average	3	2	0	0	0	0	0	0	0	2	0	0	3	0	0

0-Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlate

This Curriculum will be published and implemented from Academic Year 2025-2026

SEMESTER – VI

Course Code	IN 1615						**Course category**			**MM4**	
Course Name	**INDUSTRIAL AUTOMATION**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Curriculum will be published and implemented from Academic Year 2025-2026

SEMESTER – VII

Course Code	IN 1715						**Course category**			**MM5**	
Course Name	**PROGRAMMING FOR PLC,DCS &SCADA**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Curriculum will be published and implemented from Academic Year 2026-2027

Curriculum Structure for
Multi-Disciplinary Minor (MDM)
Degree in
Banking and Finance

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF INSTRUMENTATION ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

The Instrumentation engineering minor is tailored to students who want to understand the fundamentals of Banking and Finance related courses which is other than courses covered in engineering sciences. The students will develop abilities in to understand the fundamentals of Banking and ,Finance .Students will learn the concepts and implement the strategies in good banking and finance sectors

The students can combine the skills and technological expertise of this minor with a major in technology of aligned branch to prepare for a wide variety of opportunities in banking and finance fields and in demand careers.

B. Structure of the MDM course:

Instrumentation Engineering Department offer Multidisciplinary Minor Basket , Track-2 (Banking and Finance)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme						Total	Credits
							Theory				Practical			
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	IN1316	Bank operations Management	3			3	15	15	10	60			100	3
MM2	IN1416	Strategic management and innovation in banking	3			3	15	15	10	60			100	3
MM3	IN1516	Security analysis and portfolio management	3			3	15	15	10	60			100	3
MM4	IN1616	Spreadsheet based data analysis	3			3	15	15	10	60			100	3
MM5	IN1716	IT operations &Management	2			2	15	15	10	60			100	2
Total			14	0	0	14	75	75	50	300	0	0	500	14

C. Eligibility criteria:
Students enrolled in B. Tech program other than Instrumentation Engineering are eligible. The allotment of minor degree Programme will be as per the policy of the Institute.

D. Intake : Minimum 15

SEMESTER – III

Course Code	IN 1316					**Course category**			MM1	
Course Name	**BANKING OPERATION AND MANAGEMENT**									
Teaching Scheme				**Examination Scheme**						**Credits**
				Theory					Practical	Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objective :

This course aims at enabling the students to understand and to contribute to the strategic operational policies and practices of commercial banks management in a competitive environment

Introduction –Scheduled and non scheduled banks, origin and developments, evolution and growth of banking system in India, present structure of banking

Concept of Bank marketing, formulating and implementing marketing strategies for commercial bank ,relationship banking concept and strategy

Liquidity, purpose, sources, measurement, liquidity, profitability problems , theories of liquidity management, priorities in the employment of bank funds ,capital adequacy in banks

Credit Management : cardinal principal of sound bank lending, formulating loan policy, factors influencing loan policy, contents of loan policy ,evaluating credit applicant, loan supervision

Investment Management: Nature and significance of investment management in commercial banks, fundamental principles of security investment by commercial bank ,management of security investment ,reviewing investment portfolio, organization of investment function

Asset Liability Management and Non performing asset : concept of Asset Liability Management ,objectives ,functions,processes,measurement and management risks, concept of NPAs, NPAs in Indian commercial banks, causes, suggestions and steps for containing NPAs, Prudential norms

Text Books /Reference Books

1   Srivastava, Divya Nigam, Manageent of Indian financial Institutions, Himalaya Publishing house

2   M.Y.Khan,Indian Financial System,Tata Mc Graw Hill

3   Bharati Pathak,Indian Financial System

4   Gerald Halter,Bank Investments and Funds Management ,McMillan

5   Stigum,Managing Bank Assets and Liabilities,Dow-Jones Irwin

6   Dudley Luckett,Money and Banking ,Mc Graw Hill

7   Vasant Joshi ,Vinay Joshi ,Managing Indian Banks, -Challenges Ahead Response Books

Journals: Professional Banker

Coure Outcome

IN1316.1   Gain thorough understanding with fundamentals of Banking operation & Management

IN1316.2   Express the liquidity system in banking

IN1316.3   Explore the credit management system and loan system in banking

IN1316.4   Explore the investment portfolio with good strategy

IN1316.5   Identify the ALM and NPA in banking

CO PO PSO Mapping

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1316.1	--	--	--	--	--	--	--	--	--	--	3	--	2	--	2
IN1316.2	--	--	--	--	--	--	--	3	--	--	2	--	1	--	3
IN1316.3	--	--	--	--	--	--	--	3	--	--	2	--	3	--	1
IN1316.4	--	--	--	--	--	--	--	--	--	--	3	--	1	--	3
IN1316.5	--	--	--	--	--	--	--	2	--	--	3	--	1	--	--
Average	0	0	0	0	0	0	0	2.67	0	0	2.6	0	1.6	0	2.25

-- - Not correlated   1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	IN 1416					**Course category**				**MM2**
Course Name	**Strategic Management and Innovation in Banking**									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory					Practical	Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objective:

The course aims to provide the cutting edge knowledge on the subject to the functionaries working at various positions. Strategic management provides the objective oriented approach to identify the steps an organization can initiate to grow and improve its financial health.

Course Contents :

Strategy and strategic leadership in dynamic times –Introducing strategic management ,leading strategically through effective vision and mission

Strategic Thinking

Meaning ,foundation of strategy ,strategic intelligence including strategy analytics, appreciation of conflicts including resources ,strategic finance management ,strategic asset management

Innovation and Technology factor

Innovation, Strategic management of innovation and challenges, strategy design process, Management of technological innovation and challenges

Digital Factor

Digitalization, payment system, strategic digital banking and capabilities applied and required along the stages of the customer journey, big data, social media.

Sustainability, effects and measures

Trough an index score (including social, environment, economic and developing the index)corporate social responsibility in banks

Text/Reference Books:

1 Strategic management and Innovation in banking -Indian Institute of Banking and finance

2 Ethics in Banking - Indian Institute of Banking and finance

3 John A Peace II ,Richard B ,Amita Mital ,Strategic Management planning for domestic and global competition ,Tata McGraw Hill

Course Outcomes:

IN1416.1   Address the banking and strategy in the context of fast changing environment

IN1416.2   Analysis of the strategy asset management system

IN1416.3   Explore the management of technological innovation in banking

IN1416.4   Demonstrate the digital technology system in banking

IN1416.5   Explore the Corporate social responsibility in banking system

CO PO PSO Mapping

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1416.1	--	--	--	--	--	--	--	2	--	--	3	--	--	--	2
IN1416.2	--	2	--	--	--	--	--	2	--	--	3	--	--	--	3
IN1416.3	--	--	--	--	3	--	--	2	--	--	--	--	2	--	3
IN1416.4	--	--	--	--	3	--	--	2	--	--	--	--	3	--	--
IN1416.5	--	--	--	--	--	--	--	3	--	--	--	--	--	--	3
Average	0	2	0	0	3	0	0	2.2	0	0	3	0	2.5	0	2.75

0 - Not correlated   1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

SEMESTER V

Course Code	IN 1516						Course category				MM3	
Course Name	SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT											
Teaching Scheme				**Examination Scheme**								**Credits**
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

SEMESTER VI

Course Code	IN 1616						Course category				MM4	
Course Name	SPREADSHEET BASED DATA ANALYSIS											
Teaching Scheme				**Examination Scheme**								**Credits**
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

SEMESTER VII

Course Code	IN 1716						Course category				MM5	
Course Name	IT OPERATION AND MANAGEMENT											
Teaching Scheme				**Examination Scheme**								**Credits**
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

This curriculum IN 1516, IN1616, IN1716 will be published and implemented from AY 2024-2025 ONWARDS

Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in Data Science

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

Program Specific Outcome (PSO's)

PSO 1: The ability to understand, analyze and demonstrate the knowledge of human cognition, Artificial Intelligence, Machine Learning and data engineering in terms of real world problems to meet the challenges of the future.

PSO 2: The ability to develop computational knowledge and project development skills using innovative tools and techniques to solve problems in the areas related to Deep Learning,

PSO 3: Ability to contribute to problem identification, analysis, design, and development of systems using principles and concepts of Artificial Intelligence and Data Science.

A. Preamble:

The preamble of data science sets the foundational principles and objectives for the field. It typically emphasizes the interdisciplinary nature of data science, its reliance on various techniques from statistics, computer science, and domain-specific knowledge, and its overarching goal of extracting insights and knowledge from data to inform decision-making and solve complex problems. This preamble often underscores the importance of data collection, data processing, analysis, interpretation, and communication of findings. Additionally, it may highlight ethical considerations, such as privacy, fairness, and transparency, as well as the need for continuous learning and adaptation in response to evolving technologies and data landscapes.

Data Science being a multidisciplinary field that has its roots in statistics, math and computer science, posits immense value to students across disciplines in their multi-fold application areas. The various skill sets required in this domain is illustrated below:

B. Structure of the MDM course:

<table>
<tr><th colspan="17">CSE Department offer Multidisciplinary Minor Basket , Track-1 (Data Science)</th></tr>
<tr><th rowspan="3">Category</th><th rowspan="3">Course Code</th><th rowspan="3">Name of the Course</th><th colspan="4" rowspan="2">Teaching Scheme</th><th colspan="7">Evaluation Scheme</th><th rowspan="3">Credits</th></tr>
<tr><th colspan="4">Theory</th><th colspan="2">Practical</th><th rowspan="2">Total</th></tr>
<tr><th>TH</th><th>TU</th><th>PR</th><th>Total</th><th>CT1</th><th>CT2</th><th>TA</th><th>ESE</th><th>ICA</th><th>ESE</th></tr>
<tr><td>MM1</td><td>CS1315</td><td>Fundamentals of data science</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM2</td><td>CS1415</td><td>Computational Data Analytics</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM3</td><td>CS1515</td><td>Natural Language Processing</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM4</td><td>CS1615</td><td>Application of data science</td><td>3</td><td></td><td></td><td>3</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>3</td></tr>
<tr><td>MM5</td><td>CS1715</td><td>Marketing Analytics for Big Data</td><td>2</td><td></td><td></td><td>2</td><td>15</td><td>15</td><td>10</td><td>60</td><td></td><td></td><td>100</td><td>2</td></tr>
<tr><td colspan="3">Total</td><td>14</td><td>0</td><td>0</td><td>14</td><td>75</td><td>75</td><td>50</td><td>300</td><td>0</td><td>0</td><td>500</td><td>14</td></tr>
</table>

C. **Eligibility criteria:** Students enrolled in B. Tech program other than Computer Science & Engineering are eligible. The allotment of minor degree Program will be as per the policy of the Institute.

D. Intake: Minimum 15,

SEMESTER – III

Course Code	CS1315								Course category			MM1
Course Name	**FUNDAMENTALS OF DATA SCIENCE**											
Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	**2**hr **3**0 min	00	00	100	03

Course Objectives:

To make the students aware and understand:
1. Describe the significance of data science and understand the Data Science process.
2. Explain how data is collected, managed and stored for data science.
3. Analyse Basic tools of EDA, Data science process with case studies and Different algorithms.
4. Analyse Data using various Visualization techniques.
5. Explore Feature Generation and Feature Selection.

Course Contents:

Introduction To Data Science: Definition, Big Data and Data Science Hype, Datafication , Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions, Modeling, Philosophy of Exploratory Data Analysis, The Data Science Process.

Mathematical Preliminaries: Probability, Descriptive Statistics, Correlation Analysis.
Probability Distribution: Conditional Probability and Bayes' Theorem, Random variable and probability distribution. Probability Density Function (PDF) and Cumulative Distribution Function (CDF) of a Continuous Random variable. Various probability distribution (Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Chi-Square, Student's t-distribution, F-distribution)

Inferential Statistics: Sampling and its various techniques , Estimation, Sampling distribution of mean and proportion, Normal distribution and z — statistic, Central limit theorem, Confidence Interval estimation for mean and proportion, sample size estimation, estimation of parameters.

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: RealDirect (online real estate firm). Algorithms, machine Learning Algorithms, Three Basic Algorithms: Linear Regression, k-Nearest Neighbours (kNN), k-means, R Programs for the algorithms

Text Books:
1. Steven S. Skiena, "The Data Science Design Manual", Springer 2017.
2. Rachel Schutt & O'neil, "Doing Data Science", Straight Talk from The Frontline O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.

Reference Books :
1. Cathy O Neil, Rachel Schutt, 2014, "Doing Data Science-Straight Talk from the Frontline", Orielly
2. Joel Grus," Data Science from Scratch" First Edition, April 2015

Course Outcomes:
At the end of the course the student will be able to:
CS1315.1 Understand the concepts of Data collection and management.
CS1315.2 Understand types of data Visualization techniques.
CS1315.3 Analyze the Feature Selection algorithms and Recommendation Systems.
CS1315.4 Explain and programme Data Science, Big data and fitting model.
CS1315.5 Design Map Reduce Solutions.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1315.1	0	3	3	2	2	2	0	2	3	3	3	1	1	2	3
CS1315.2	1	2	2	1	3	1	2	1	0	1	2	2	1	1	3
CS1315.3	2	1	3	1	0	2	2		2	1	0	2	2	0	0
CS1315.4	3	2	3	1	2	0	1	2	1	3	1	2	0	3	2
CS1315.5	2	3	1	3	1	3	1	0	2	3	3	3	2	0	0

0-Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlate

SEMESTER – IV

Course Code	CS1415								Course category			MM2
Course Name	**COMPUTATIONAL DATA ANALYTICS**											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr 30 min	00	00	100	03

Course Objectives:
1. To explore data for understanding data characteristics.
2. To explore the statistical analysis techniques for analyzing data.
3. Tolearntheprobabilitydistributionsanddensityestimationstoperformanalysisof various kinds of data.
4. To analyze the data generated in real life problems with the help of important statistical tools and techniques.
5. To understand the application of data science in various sectors.

Course Contents:

Data analytics importance and overview: Data analytics benefits, Terminologies in data analytics, Data categorization (constant and variable; discrete and continuous; Qualitative and Quantitative; structure, semi-structured and unstructured, cross-sectional, time-series and panel), data measurement scale. Types of Analytics (Descriptive, predictive, prescriptive, diagnostic) Descriptive Analytics: Measures of Central Tendency, Measures of Variation, Measures of Shape and symmetry.

Data Munging: Properties of Data, Languages for Data Science, Collecting Data, Cleaning Data, Crowdsourcing.

Visualizing Data: Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types, Great Visualizations Mathematical Models: Philosophies of Modelling, A Taxonomy of Models, Baseline Models, Evaluating Models, Evaluation Environment.

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.

Data Engineering: Map reduce, Word Frequency Problem, Map Reduce Solution, Other Examples of Map Reduce, Mining Social Network Graphs: Social networks as graphs, clustering of graphs, direct discovery of communities in graphs, Partitioning 2 of graphs

Data analytics in different sectors: How Google, LinkedIn, Amazon, Netflix uses analytics Data analytics in media and entertainment industry, education, government, weather forecasting.

Course Outcomes:

At the end of the course the student will be able to:

CS1415.1 Understand and describe the role of data science and its tools.
CS1415.2 Apply mathematical and statistical principles to the analysis of data.
CS1415.3 Apply correlations, distributions and hypothesis tests for inference.
CS1415.4 Apply basic analysis techniques for real time problems.
CS1415.5 Implement data analytics in different sectors.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1415.1	2	1	2	2	3	2	0	1	0	1	0	1	2	2	1
CS1415.2	2	1	2	2	3	2	0	1	0	1	0	2	2	3	2
CS1415.3	3	3	3	3	3	0	0	2	1	1	0	2	2	2	2
CS1415.4	3	3	3	3	3	0	0	2	1	1	0	2	2	3	2
CS1415.5	3	3	3	3	3	0	0	2	1	1	0	1	2	3	2

0- Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlate

Curriculum Structure for Multi-Disciplinary Minor (MDM) Degree in Artificial Intelligence

(In light of NEP 2020)

(NEP_Version II)

Offered By

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

For students admitted in 2023-24 onwards
Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

A. Preamble:

It focusses on integrating AI and Machine Learning skills to all core engineering students to enhance their employability skills. The prime objective of this Programme is to develop students to excel in Machine Learning specific areas by exposing them to understand mathematical, statistical, and biologically inspired computational models with engineering and scientific principles to devise solutions for societal and business problems. As the business world witnesses the power of data-driven decision making, there is a lot of demand for professionals who can build and execute mathematical and statistical models/algorithm. To harness the power of data, effective methodologies are required for extracting hidden patterns from the data. This Programme focusses more on algorithmic aspects of AI and Machine Learning where students study various statistical and machine learning algorithms, neural network architectures, methods to build ML stack, and required technologies for building and hosting ML models. The courses in this Minor degree designed to introduce the students to core skills such as foundations of Artificial Intelligence, Machine learning, Feature Engineering for ML, Data Analytics and Deep learning architectures and its applications.

B. Structure of the MDM course:

CSE Department offer Multidisciplinary Minor Basket , Track-1 (Artificial Intelligence)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM1	CS1316	Introduction to Artificial Intelligence	3			3	15	15	10	60			100	3
MM2	CS1416	Data Mining	3			3	15	15	10	60			100	3
MM3	CS1516	Introduction to Machine Learning	3			3	15	15	10	60			100	3
MM4	CS1616	Optimization Methods in Machine Learning	3			3	15	15	10	60			100	3
MM5	CS1716	Human Applications of AI	2			2	15	15	10	60			100	2
Total			14	0	0	14	75	75	50	300	0	0	500	14

C. **Eligibility criteria:** Students enrolled in B. Tech program other than Mechanical Engineering are eligible. The allotment of minor degree Programme will be as per the policy of the Institute.

D. Intake: Minimum 15,

SEMESTER – III

Course Code	CS1316								**Course category**			MM1
Course Name	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**											
Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr 30 min	00	00	100	03

Course Objectives:

1. To understand the concept of Artificial Intelligence
2. To apply the methods of solving problems using Artificial Intelligence.
3. To learn the knowledge representation techniques, reasoning techniques and planning
4. To introduce the concepts of Expert Systems and machine learning.
5. To implement the classification and clustering methods for complex problems.

Course Contents:

Introduction: The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Problem Solving: Problem-Solving Agents, Example Problems, searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions

Search Algorithms: Problem solving agents, search algorithms terminologies, properties of search algorithms, types of search algorithms. Uniformed/Blind Search Algorithms: Breadth-first Search, Depth-first Search, Depth-limited Search, Iterative deepening depth-first search, Uniform cost search, Bidirectional Search.

Regression: Linear Regression- Model representation for single variable, single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.
Logistic Regression- Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.

Clustering: clustering as a machine learning task, different types of clustering techniques, partitioning methods, k-medoids, hierarchical clustering. Use-cases centered on classification and clustering.

TEXT BOOKS:
1. Rich & Knight, Artificial Intelligence, second edition, Tata McGraw Hill
2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd edition, Prentice Hall, 2009.
3. Machine Learning, Saikar Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson India

REFERENCES:

1. Practical Workbook Artificial Intelligence and Soft Computing for Beginners, Anindita Das
    Bhattacharjee, and Shroff Publisher-X team Publisher
2. Machine Learning, Tom Mitchell, McGraw Hill, 2017
3. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2011
4. The Elements of Statistical Learning, T. Hastie, R. Tibshirani, J. Friedman, 2 nd Edition, 2011

Course Outcomes:

CS1316.1 Illustrate the scope of Artificial Intelligence in the real world

CS1316.2 Demonstrate various machine learning algorithms and its preliminaries

CS1316.3 Summarize and learn various supervised learning algorithms

CS1316.4 Describe and apply the concepts of classification and regression

CS1316.5 Summarize and learn various unsupervised learning algorithms

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1316.1	0	3	3	2	2	2	0	2	3	3	3	1	1	2	3
CS1316.2	1	2	2	1	3	1	2	1	0	1	2	2	1	1	3
CS1316.3	2	1	3	1	0	2	2		2	1	0	2	2	0	0
CS1316.4	3	2	3	1	2	0	1	2	1	3	1	2	0	3	2
CS1316.5	2	3	1	3	1	3	1	0	2	3	3	3	2	0	0

0- Not correlated   1 - Weakly Correlated 2- Moderately Correlated   3- Strongly Correlate

Course Code	CS1416								**Course category**			MM2
Course Name	**DATA MINING**											
Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	3hr 00 min	00	00	100	03

Course Objectives:

1. To learn about data mining Concepts.
2. To study the different data mining techniques.
3. To have knowledge in Data mining concepts.
4. To apply Data mining concepts in different fields.
5. To apply association rules to measure the quality of data.

Course Contents:

Basic Data Mining Tasks – Data Mining Versus Knowledge Discovery in Data Bases – Data Mining Issues – Data Mining Matrices – Social Implications of Data Mining – Data Mining from Data Base Perspective.

Data Mining Techniques – a Statistical Perspective on data mining – Similarity Measures – Decision Trees – Neural Networks – Genetic Algorithms.

Classification: Introduction – Statistical – Based Algorithms – Distance Based Algorithms – Decision.

Clustering Tree – Based Algorithms – Neural Network Based Algorithms – Rule Based Algorithms – Combining Techniques: Introduction – Similarity and Distance Measures – Outliers – Hierarchical Algorithms. Partitioned Algorithms.

Association Rules: Introduction - Large Item Sets – Basic Algorithms – Parallel & Distributed Algorithms – Comparing Approaches – Incremental Rules – Advanced Association Rules Techniques – Measuring the Quality of Rules.

TEXT BOOK:

1. Jiawei Han & Micheline Kamber, "Data Mining Concepts & Techniques", 2011, 3 rd Edition.

REFERENCE BOOK:

1. Margaret H.Dunbam, "Data Mining Introductory and Advanced Topics", Pearson Education 2003.

WEB REFERENCES:

NPTEL & MOOC courses titled Data Mining ¬ https://nptel.ac.in/courses/106105174/

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1316.1	0	3	3	2	2	2	0	2	3	3	3	1	1	2	3
CS1316.2	1	2	2	1	3	1	2	1	0	1	2	2	1	1	3
CS1316.3	2	1	3	1	0	2	2		2	1	0	2	2	0	0
CS1316.4	3	2	3	1	2	0	1	2	1	3	1	2	0	3	2
CS1316.5	2	3	1	3	1	3	1	0	2	3	3	3	2	0	0

0- Not correlated   1 - Weakly Correlated   2- Moderately Correlated   3- Strongly Correlate