AY 2024-25

Course Information

Programme	B.Tech.
Class, Semester	SY BTech Sem - IV
Course Code	7MD221
Course Name	Introduction to Electric Vehicle
Desired Requisites:	Nil

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3Hrs/week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
	-		Credits: 3		

Course Objectives

1	Study the key components of EVs, such as batteries, electric motors, inverters, charging systems, and energy management systems.
2	Gain knowledge of the electric powertrain, including electric motors, controllers, and battery management systems.
3	Investigate the global market trends for EV adoption, including government incentives, market barriers, and consumer behaviour

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Learn the basics of EVs, including their components, how they differ from internal combustion engine (ICE) vehicles, and their importance	II	Understand
CO2	Design and analyse the electric powertrain system of an EV, including electric motor selection, inverter design, and drivetrain integration.	IV	Analyse
CO3	Evaluate the performance characteristics of electric vehicles, including acceleration, braking, and overall efficiency, and relate these to vehicle design parameters.	V	Evaluate

Module	Module Contents	Hours
I	**Background Details to Electric Vehicle (EV)** EV Historical Background, EV Benefits of Using EVs, EV Overview of types of EVs and its Challenges, EV Motor Drive Technologies, EV Energy Source Technologies	6
II	**Electric Vehicle Dynamics (Subsystems and Configuration)** EV Subsystems and Modes of Operation. Vehicle Dynamics intro and tractive effort Configuration locomotive drives- series parallel switching- load tracking architecture. Mild hybrid- power assist- dual mode- power split- power split with shift, Continuously Variable transmission (CVT)- wheel motors.	6
III	**Electrical & Electronic Components**	7

	Purpose and operation of electrical components like switches, relays, solenoids etc. Purpose of circuit protection devices like fuses, circuit breakers and fusible links. Working of Electromagnetic gauges like temp Gauges, fuel gauge, engine oil pressure gauge, Speedo-meter gauge. Working of electrical accessories like windshield wiper, washer pumps, electrochromic mirror, power window, power seat, power door lock.	
IV	**Clutches, Gear Box and Final Drive** Principle, functions, general requirements, types of clutches Necessity of gear box, Requirements of gear box, Functions of gear box, Types of gears used in transmission, Gear shifting mechanism. Propeller shaft, universal joints, hooks and constant velocity joints, Drive line arrangements –Different types of final drives, need of differential.	7
V	**Battery (Fuel Cells)** Lead acid battery–components &operation. Maintenance free battery–construction. Concept of Low maintenance battery. Battery maintenance and safety precautions. Battery testing–Battery terminal test, Leakage test, Open circuit test, Capacity test. Battery charging–Initial charging procedure, dry charged battery precautions. Jump Starting-Procedure and precautions. Factors affecting battery life. Battery failures–cycle failure, internal short circuit, over charging.	6
VI	**Brake, Steering and Suspension System** Concept, function, working principle and necessity of brakes. Classification of brakes and braking systems. Electrical braking systems. Concept, function, working principle of Steering system. Electric power steering system (EPS) and its components. Concept, function, working principle and necessity of suspension system (ESS), electronic suspension system (ESS)	7

Text Books

1	Sandeep Dhameja "Electric Vehicle Technology" Macmillan India 2009
2	G. S. S. Raju & K. R. Padiyar "Electric Vehicles: The Way Forward" Wiley India 2017
3	D. K. Kothari & I. J. Nagrath "Electric Vehicle Engineering"McGraw-Hill Education 2019

References

1	John M. Miller "Electric Vehicle Engineering" CRC Press 2010
2	James L. W. Meintjes "Electric and Hybrid Vehicles: Design Fundamentals" CRC Press 2012
3	Ali Emadi "Advanced Electric Drive Vehicles" CRC Press 2014
4	S. K. Gupta "Hybrid Electric Vehicles: Principles, Design, and Applications" PHI Learning Private Limited 2012

Useful Links

1	https://archive.nptel.ac.in/courses/108/106/108106170/
2	https://nptel.ac.in/courses/108102121
3	https://www.shiksha.com/online-courses/fundamentals-of-electric-vehicles-technology-economics-course-nptel818

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3									1				
CO2		3	3	1					3					
CO3	2	2		3			2							

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)

The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3.ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	MDM (Smart Cities)
Class, Semester	B Tech, IV Semester
Course Code	7MD222
Course Name	Introduction to Urban Planning
Desired Requisites:	NIL

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Practical	-				
Interaction	-	Credits: 3			

Course Objectives

1	To understand the evolution and foundations of Urban Planning.
2	To analyse urbanization patterns and growth dynamics.
3	To assess urban planning principles to address contemporary challenges.

Course Outcomes (CO)

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

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Explain urbanization in terms of planning, growth and associated challenges.	Understanding	2
CO2	Apply the concept of urban planning.	Applying	4
CO3	Analyze the urban growth patterns and predict the future trends.	Analyzing	3
CO4	Implement the GIS for data collection and analysis for urban planning.	Applying	4

Module	Module Contents	Hours
I	**Evolution of town planning** Evolution in planning and physical form, Concept of urban human settlement, Differentiation between rural and urban settlement, concept of town, Evolved and Created Town Characteristics, Features of urban planning process, Role of urban planner, Genesis of urban form; Social, Geographical and Cultural impacts, Contemporary developments in planning, Impacts of Industrial revolution on town and regional planning, Characteristics of settlements.	5
II	**Urbanization** Demography and Census Statistics- Significance of Census and Demographics- Planning policies framed based on Census-Use of Census Data in Urban Planning Rural and urban Migration, Planning process, components and techniques; Concept of Master Plan; its elements, preparation and implementation; Perspective Plan, Perspective plan , Zonal plan, Participatory and inclusive planning, Town and Country Planning Acts, concept of modern cities, MR & TP act.	8
III	**Urban Growth** Elements of town structure, Town classification: Functional and geographical; City Centre, walled city and Urban Fringe areas; classification based on socio-cultural characteristics, changes with time and growth, growth theories, Characteristics of the urban environment and its components, Modern urban forms, peri- Urban Areas- Urban Fringe- Issues	6

IV	**Urban Planning Principles and Policies** Objectives and Principles of Urban planning, Environmental aspects of land use planning, concept of town planning scheme, Role of URDPFI guidelines in Town planning, demand and supply of land relationship, Government policies of urban development, Role of Professional bodies Concept of Neighbourhood Planning, Satellite Towns, Government Policies for small and medium towns, Urban and Rural Planning Rural-Urban Fringe.		7
V	**Remote Sensing and GIS for Urban Planning** Introduction to Remote Sensing and GIS for Urban Planning, Urban Land Use and Land Cover Analysis, GIS-Based Spatial Analysis for Urban Infrastructure, Remote Sensing for Disaster and Risk Management in Urban Areas, Sustainable Urban Development Using GIS Tools, Application of total station, drone, GPS, computer aided design in urban planning.		6
VI	**Urban Legislation and Challenges** Impacts of urbanisation, socio – economic impacts of growth of population, Social and Economic Environmental Administrator, Levels of Urbanisation, Indian scenario - Issues and Policies, Global scenario, Future trends of urbanization, Case Studies. Legislation as tools of plan implementation and development ; Review of Planning legislation in India , complaint and redress mechanism.		8

Text Books

1	K. C. Shivrama Krishnan, "Revisioning Indian Cities", Sage Publications.
2	R. Ramachandran, "Urbanisation and Urban Systems in India", Oxford Publications.
3	Urban and Regional Development Plan Formulations and implementation (URDPFI) guidelines , 2015.

References

1	A.B. Gillion and Simon Eisner, "The Urban Pattern", CBS Publishers and Distributors, Delhi.
2	Rishma A., "Town Planning in Hot Cities", Mir Publishers, Moscow..
3	Ward S (2002), "Planning the 20th Century City" John Wiler & Sons.
4	Rangwala S.C" Town Planning"

Useful Links

1	https://youtu.be/q_XmlG3CwNk?si=VP4rKCERXLKlgspV
2	https://youtu.be/RqdaT3LLctU?si=uSUnIy4fX8IX8K2K
3	https://onlinecourses.nptel.ac.in/noc22_ar18/preview

CO-PO Mapping

COs	Programme Outcomes (PO)												PSPO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2			3											
CO3				2										
CO4				2										

Assessment

o The assessment is based on MSE, ISE, and ESE.

o MSE shall be typically on modules 1 to 3.

o ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.

o ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.

o For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Prepared by	DAC/BoS Secretary	Head/BoS Chairman

Walchand College of Engineering, Sangli
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AY 2024-25

Course Information

Programme	B.Tech. (All Branches)
Class, Semester	Second Year B. Tech., Sem II
Course Code	7MD223
Course Name	Introduction to Financial Markets
Desired Requisites:	

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	ISE	MSE	ESE	Total
Tutorial		20	30	50	100
Practical	-				
Interaction	-	Credits: 3			

Course Objectives

1	To provide foundational knowledge of financial markets, instruments, and their role in the economy.
2	To introduce key financial instruments and asset classes such as equity, debt, derivatives, and mutual funds.
3	To develop an understanding of the principles of accounting, investing, trading, and risk management in capital markets.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand the structure and functioning of financial markets.	Understand
CO2	Analyze the characteristics of financial instruments, including equity, debt, and alternative assets.	Analyze
CO3	Apply the concepts of accounting to prepare and interpret financial statements.	Apply
CO4	Evaluate investment opportunities and strategies, including mutual fund performance.	Evaluate

Dr. B. F. Momin
Coordinator MDD-finTech
10/01/2025

11/01/25
DAC, CSE

HOD 11.1.25
CSE

Module	Module Contents	Hours
I	**Module 1: Basics of Accounting – Principles and Concepts** **Financial Accounting:** Key accounting principles and concepts, significance of accounting. Accrual vs. cash accounting, double-entry bookkeeping. **Overview of the accounting cycle:** Journal, ledger, trial balance.	4
II	**Module 2: Financial Statements and Ratios** **Understanding financial statements:** Balance Sheet, Profit & Loss Account, and Cash Flow Statement. **Financial ratios and their implications:** Liquidity, profitability, and leverage ratios. **Practical exercises:** Preparing basic financial statements.	8
III	**Module 3: Introduction to Financial Markets** **Overview of financial systems:** Intermediaries, regulators, and participants. **Functions of financial markets:** Allocation of resources, risk management, and price discovery. **Types of financial markets:** Money Market vs. Capital Market; Primary vs. Secondary Market. **Regulatory Framework in India:** Role of SEBI and RBI.	9
IV	**Module 4: Capital Market Instruments – Equity** **Equity instruments:** Share and Stock Market operations - IPOs, FPOs, stock exchanges, indices, and trading mechanisms, Key factors influencing equity prices, Risk-return trade-off in equity investments.	5
V	**Module 5: Capital Market Instruments – Debt** **Debt instruments:** Bonds, debentures, and fixed-income securities. Bond valuation, yield, maturity, and duration.	5
VI	**Module 6: Mutual Funds and Alternative Investments** **Overview of mutual funds:** Structure, types, and advantages. Net Asset Value (NAV) and fund performance metrics. **Introduction to alternative investments:** Real estate, commodities, private equity and hedge funds. **Fund Types:** Active vs. Passive, ETFs, Index Funds	8

Text Books	
1	*Indian Financial System* by Bharati V. Pathak (Pearson).
2	*Financial Accounting: A Managerial Perspective* by R. Narayanaswamy (PHI Learning).

Reference Books		
1		*Investment Analysis and Portfolio Management* by Prasanna Chandra for capital markets.
2		*Mutual Funds in India: Structure, Performance, and Prospects* by Amit Singhal (Springer).

Useful Links
NSE India: https://www.nseindia.com - Official site of the National Stock Exchange of India.
BSE India: https://www.bseindia.com - Official site of the Bombay Stock Exchange.
Investopedia: https://www.investopedia.com - Comprehensive resource for financial concepts, markets, and instruments.
SEBI: https://www.sebi.gov.in - Securities and Exchange Board of India official site for regulations and updates.
RBI: https://www.rbi.org.in - Reserve Bank of India official site for monetary policy and regulations.
Khan Academy – Finance and Capital Markets: https://www.khanacademy.org - Free tutorials on financial instruments, markets, and accounting.
Morningstar: https://www.morningstar.in - Resource for mutual fund analysis and performance tracking.
Zerodha Varsity: https://zerodha.com/varsity/ - Resource for Stock Market and Financial Education

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1													
CO2	1	2												
CO3	2				1				1					
CO4		1		1										

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment (for Theory Course)
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli
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AY 2024-25

Course Information

Programme	MDM in Geomatics Engineering
Class, Semester	Second Year , B. Tech Sem IV
Course Code	7MD224
Course Name	Surveying and Mapping
Desired Requisites:	Engineering graphics, basic geometry and geography

Teaching Scheme		Examination Scheme (Marks)			
		MSE	ISE	ESE	Total
Lecture	2 Hrs/week	30	20	50	100
Tutorial	1 Hr/week				
Practical	-				
Interaction	-	Credits: 3			

Course Objectives

1	To understand the importance of maps in engineering projects and the principles of map preparation.
2	To learn land surveying methods and instruments used in civil engineering.
3	To learn the concepts and applications of topographical mapping.

Course Outcomes (CO)

CO	Description	Blooms Taxonomy	
		Descriptor	Level
CO1	Identify and classify different types of maps and scales, and understand coordinate systems and map projections.	Understanding	I
CO2	Apply various land surveying techniques for engineering projects.	Applying	III
CO3	Utilize principles of aerial photogrammetry for terrain modelling.	Applying	III
CO4	Understand GPS functioning and its use in surveying and mapping	Understanding	III

Module	Module Contents	Hours
I	**Principles of Land Surveying** Overview of survey levels and their classifications. Levelling methods: Differential levelling, reciprocal levelling, and precise levelling. Surveying instruments: Compass, Theodolite, Total Station, and Tachometer. Applications of surveying in infrastructure development.	4
II	**Advanced Surveying Techniques** Trigonometric levelling: Concepts and applications. Traversing: Methods, adjustments, and plotting. Triangulation and trilateration: Principles, computations, and applications.	4
III	**Coordinate systems** Cartesian and geographical map projections and their types: Conformal, equal-area, and equidistant. Map datum: Concepts of MSL (Mean Sea Level), Geoid, spheroid, and WGS-84. Importance of map datum in GIS and engineering applications. Systems and Map Projections	5
IV	**Introduction to Maps** Definition and significance of maps in engineering projects. Types of maps: Topographical maps, cadastral maps, thematic maps, engineering maps. Scales of maps: large scale, medium scale, small scale, and their applications. Plotting accuracy and precision in map-making. Map sheet numbering and standardization.	5

A. A. Magdum.

V	**Aerial Photogrammetry** Types of aerial photographs: Vertical, oblique, and panoramic. Flying height, scale, and their importance in photogrammetry. Relief displacement and its effects on map accuracy. Introduction to Digital Elevation Models (DEM). Applications of DEM in slope analysis and topographical mapping. Introduction to stereoscopy and creation of 3D models.		4
VI	**Global Positioning Systems** Introduction to GPS: GPS signal structure, GPS modernization, types of GPS receivers, time systems, pseudo-range measurements, GPS measurements. GPS errors and Biases: GPS ephemeris errors, Selective availability, satellite receiver, and clock error, multipath error, ionospheric error, tropospheric errors Applications: GPS for utilities industry, forestry and natural resources, precision farming.		4

Text Books

1	Bindra S. P., "A Course in Highway Engineering", Dhanpat Rai Publications, 5th Edition 2012.
2	Kang-tsung Chang, "Introduction to Geographic Information Systems", Tata McGrawHill, 4thEdition, 2007
3	Ian HeyWood, Sarah Cornelius and Steve Carver , "An Introduction to Geographical Information Systems" , Pearson Education, 2nd Edition, 2006

References

1	Fundamentals of Global Positioning System Receivers: A Software Approach James Bao-Yen Tsui Copyright @ 2000 John Wiley & Sons, Inc.
2	B.C. Punmia, Ashok Kumar Jain, and Arun Kumar Jain, Surveying Vol. 1, 2 & 3.
3	

Useful Links

1	https://ocw.mit.edu/courses/12-540-principles-of-the-global-positioning-system-spring-2012/
2	https://nptel.ac.in/courses/106105219
3	

CO-PO Mapping

COs	Programme Outcomes (PO)												PSPO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		1		1		2	1	2		1	2	1	
CO2	1	2	3	1					1					1
CO3	1		2	2	1						1		1	
CO4	1				2							1	1	

The strength of mapping: - 1: Low, 2: Medium, 3: High

Assessment

- o The assessment is based on MSE, ISE, and ESE.
- o MSE shall be typically on modules 1 to 3.
- o ISE shall be taken throughout the semester in the form of a teacher's assessment. The mode of assessment can be field visits, assignments, etc., and is expected to map at least one higher-order PO.
- o ESE shall be on all modules with around 25-30% weightage on modules 1 to 3 and 70-75% weightage on modules 4 to 6.
- o For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed, and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

A.A. Makdum.

Tutorial

Tutorial 1: Principles of Land Surveying
 a. Overview of survey levels and classifications
 b. Levelling methods: Differential, reciprocal, and precise levelling

Tutorial 2: Levelling Methods
 a. Differential levelling: Procedure and accuracy
 b. Reciprocal levelling: Elimination of errors

Tutorial 3: Levelling Methods Applications of Surveying in Infrastructure Development
 a. Road alignment and construction
 b. Bridge and dam site selection

Tutorial 4: Advanced Surveying Techniques
 a. Trigonometric levelling: Concepts and field applications
 b. Traversing: Methods, plotting, and adjustments

Tutorial 5: Systems and Map Projections
 a. Introduction to map projection systems
 b. Importance of map datum in GIS and engineering

Tutorial 6: Introduction to Maps
 a. Definition and significance of maps in engineering projects
 b. Types of maps: Topographical, cadastral, thematic, engineering maps

Tutorial 7: Aerial Photogrammetry
 a. Types of aerial photographs: Vertical, oblique, panoramic
 b. Flying height, scale, and importance in photogrammetry

Tutorial 8: Global Positioning Systems (GPS)
 a. GPS signal structure and modernization
 b. Types of GPS receivers and their applications

Tutorial 9: Global Positioning Systems (GPS)
 a. GPS errors and biases: Ephemeris, selective availability, multipath, ionospheric, tropospheric
 b. Applications of GPS in utilities, forestry, and precision farming

Tutorial 10: Revision

Prepared by	DAC/BoS Secretary	Head/BoS Chairman
Mr. A. A. Magdum	Dr. S. S. Karvekar	Dr. B. F. Momin

A. A. Magdum.

Walchand College of Engineering, Sangli
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AY 2024-25

Course Information

Programme	B.Tech. (Artificial Intelligence and Machine Learning)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	7MD225
Course Name	Essentials of Artificial Intelligence and Machine Learning
Desired Requisites:	Basic of Optimization, Linear Algebra, Statistics and Probability

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	**ISE**	**MSE**	**ESE**	**Total**
Tutorial	-	20	30	50	100
		Credits: 3			

Course Objectives

1	To introduce concepts of AIML
2	To align real world problems with appropriate AIML techniques
3	To explain AIML algorithms and its categorization
4	To motivate students to generate data samples with discipline specific tasks

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Summarized AIML strategies and related terms	II	Understand
CO2	Choose relevant domain application and use patterns for training	III	Apply
CO3	Compare AIML algorithms based on logic and reasoning agents.	IV	Analyse
CO4	Recommend suitable search techniques in AIML algorithms	V	Evaluate

Module	Module Contents	Hours
I	**Introduction to AI:** History of Artificial Intelligence, Turing test, cognitive modeling, rational agent. **Applications of AIML:** Brief on: robotic vehicles, speech recognition, autonomous planning and scheduling, game playing, spam filtering, logistics planning, robotics, machine translation, LLM's, game of TicTac Toe.	6
II	**Intelligent Agents:** Agents and environments, concept of rationality, nature of environments, structure of agents, types of agents, Components of an AI Agent, brief on applications.	6

III	**Solving Problems by Searching:** Search in artificial intelligence. problem solving with search. real-world applications of search (e.g., pathfinding, games). problem representation: representing problems as state spaces. defining states, actions, and goals. brief on: uninformed search strategies, informed (heuristic) search strategies. Beyond classical search: adversarial search, constraint satisfaction problems.		7
IV	**Knowledge and Reasoning:** Logical agents, knowledge-based agents, propositional logic, propositional theorem proving, agents based on propositional logic.		6
V	**First-Order Logic:** Syntax and semantics of first-order logic, using first-order logic, knowledge engineering in first-order logic,inference in first-order logic,propositional vs. first-order inference, unification and lifting forward chaining, backward chaining,resolution.		7
VI	**Foundation of Machine Learning:** Supervised learning: regression and classification problems, simple linear regression, multiple linear regression, logistic regression.		7

Textbooks	
1	Stuart J. Russell and Peter Norvig, "Artificial Intelligence:A Modern Approach", Pearson, 4th edition,2022.
2	Deepak Khemani," A First Course in Artificial Intelligence", McGraw Hill Education (India), 2013.
3	Géron, Aurélien,"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 2nd edition, 2019.

References	
1	Norvig, P. R., & Intelligence, S. A. (2002). A modern approach. Prentice Hall Upper Saddle River, NJ, USA: Rani, M., Nayak, R., & Vyas, OP (2015). An ontology-based adaptive personalized e-learning system, assisted by software agents on cloud storage. Knowledge-Based Systems, 90, 33-48.
2	Stefan Edelkamp and Stefan Schroedl,"Heuristic Search: Theory and Applications", Morgan Kaufmann, 2011.

Useful Links	
1	https://thuvienso.hoasen.edu.vn/handle/123456789/8967
2	https://onlinecourses.nptel.ac.in/noc24_cs88/preview
3	https://onlinecourses.nptel.ac.in/noc23_cs18/preview

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													1
CO2				3		2						1		
CO3	1	3	2											
CO4	3				1								2	

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli
(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	MDM: Robotics and Automation
Class, Semester	S. Y. B. Tech. - Sem IV
Course Code	7MD226
Course Name	Robotics Fundamentals and Design
Desired Requisites:	Physics

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives	
1	To understand the fundamentals of robotics
2	To learn the working of- sensors, end effectors, drives
3	To learn the selection of sensor, drives
4	To learn basics of end effector design and robot kinematics

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Recall fundamentals of robot anatomy, sensors, end effectors, drives, power transmission and Kinematics	I	Remembering
CO2	Explain the components, working of; robot components, sensors end effectors, transmission, drives and kinematics	II	Understanding
CO3	Select appropriate sensor, end effector, drive and transmission elements	III	Applying
CO4	Analyze the design considerations of end effectors. power transmission and kinematics	IV	Analyzing

Module	Module Contents	Hours
I	**Fundamentals of Robotics** Historical development of Robotics, Definitions of Industrial Robot, Types and Classification of Robots, Asimov's laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Resolution, accuracy and precision of robot	6
II	**Sensors in robotics** Sensor characteristics, Position sensors, Encoders, Resolvers, Velocity sensors, Proximity sensors, Limit switches, Tactile sensors, Force and torque sensors, Safety Sensor: Light Curtain, Laser Area Scanner, Safety Switches, Introduction to machine vision.	6

III	**End Effectors** Grippers, Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Advance Grippers- Adaptive grippers, Soft Robotics Grippers, Tactile Sensor Grippers; Various process tools as end effectors; Robot end effectors interface, Active and passive compliance, Selection and Design Considerations	7
IV	**Robot drives** Robot drive system, Types - Pneumatic, Hydraulic, Mechanical, Electrical Drives, Salient Features, Applications and Comparison of all these Drives, Micro actuators, selection of drive. Position and velocity feedback devices.	6
V	**Power transmission** Mechanical transmission method ,Gear transmission, Belt drives, cables, Roller chains, Link, Rod systems,Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball screws.	7
VI	**Kinematics** Kinematics - Definition, Importance in robotics, Mechanisms – Terminology, Kinematic chains, inversions, Forward kinematics, inverse kinematics, Basics of matrices, Rotations & transformations, Introduction to D-H parameters and its physical significance, Orientation of gripper, Trajectory planning, Motion interpolation, Control of robot manipulators – Point to point, Continuous Path Control	7

Textbooks	
1	Groover, Mikell P. Industrial Robotics : Technology, Programming, and Applications. 2nd ed., Special Indian ed, McGraw-Hill, 1986. ISBN: 9781259006210
2	Saha, Subir Kumar. Introduction to Robotics. Second edition, McGraw Hill Education (India) Private Limited, 2014. ISBN: 9789332902800
3	Craig, John J, "Introduction to Robotics : Mechanics and Control", Fourth edition, Pearson, 2018., ISBN: 9780133489798
4	Jain, Anil K., "Fundamentals of Digital Image Processing", Prentice Hall, 1989. ISBN: 9780133361650
5	Poole, Harry H., "Fundamentals of Robotics Engineering", Springer Netherlands, 2012, ISBN: 9789401170505

References	
1	Niku, Saeed B. Introduction to Robotics : Analysis, Control, Applications. 2nd ed, Wiley, 2011. ISBN-13 : 978-9332902800
2	Khatib, Oussama, and Bruno Siciliano, "Springer Handbook of Robotics", 2nd edition, Springer International Publishing: Imprint : Springer, 2016, ISBN: 9783319325521
3	P.I. Corke, "Robotics, Vision & Control", Second edition, Springer, 2017, ISBN 978-3-319-54413-7
4	Ghosal, Ashitava. Robotics : Fundamental Concepts and Analysis. Oxford University Press, 2006. ISBN: 9780195673913
5	Mittal, R. K., and I. J. Nagrath. Robotics and Control. Tata McGraw-Hill, 2003. ISBN-13 : 978-9332902800

Useful Links	
1	https://www.automate.org/companies/robotic-industries-association

2	https://www.ieee-ras.org/
3	https://www.roboticstomorrow.com/
4	https://www.designworldonline.com/
5	https://www.therobotreport.com/
6	https://robohub.org/
7	https://www.sciencedaily.com/news/computers_math/robotics/
8	https://techxplore.com/robotics-news/
9	https://nptel.ac.in/courses/107106090
10	https://nptel.ac.in/courses/112105249
11	https://onlinecourses.nptel.ac.in/noc21_me32/preview
12	https://archive.nptel.ac.in/courses/112/101/112101099/
13	https://archive.nptel.ac.in/courses/112/107/112107289/

CO-PO Mapping															
	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1	2												2		
CO2		2											2		
CO3		2	2									2	2		
CO4			2	2								2		2	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High															

Assessment
The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)