Maratha Vidya Prasarak Samaj's

Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering

An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune

Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013,

Maharashtra, India

Syllabus

Second Year B.Tech. Automation and Robotics (2024 Pattern)

(As per NEP 2020)

Academic Year 2026-27

(Copy for Student Circulation Only)

Program Specific Outcomes (PSOs).

PSO1: Ability to design, analyze, and problem-solving skills using basic principles of automation and robotics.

PSO2: Ability to impart technical and professional skills through industry institute interaction.

PSO3: Develop practical skills for the benefit of society.

Program Educational Outcomes (PEOs).

PEO1: To prepare technocrats who can satisfy the needs of automation & robotics and allied industries.

PEO2: To develop critical thinking, problem-solving skills, research aptitude, and career and professionalism among the students.

PEO3: To improve and expand the technical and professional skills of students through effective teaching-learning and industry interaction.

Program Outcomes (POs)

PO1: **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 to develop to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development (WK1 to WK4).

PO3: **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required (WK5).

PO4: **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions (WK8).

PO5: **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

PO6: **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5 and WK7).

PO7: **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

PO8: **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) Independent and life-long learning, ii) Adaptability to new and emerging technologies and iii) Critical thinking in the broadest context of technological change. (WK8).

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas is the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Second Year B.Tech. Automation and Robotics
Curriculum Structure (2024 Pattern) Semester - III

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
109301	PCC-2	Kinematics of Machinery	2	2	-	40	60	25	25	150	2	1	-	3
109302	PCC-3	Materials and Mechanics	2	2	-	40	60	25	25	150	2	1	-	3
109303	PCC-4	Manufacturing Technology	2	-	-	40	60	-	-	100	2	-	-	2
170304/ 170404	MDM-1	Multi-Disciplinary Minor Course-1	2	-	-	40	60	-	-	100	2	-	-	2
171305/ 171405	OEC-1	Open Elective Course-1	3	2	-	40	60	25	25	150	3	1	-	4
172306/ 172406	EEM-1	EEM Course-1	-	-	2	-	-	50	-	50	-	-	2	2
173307/ 173407	VEC-1	Value Education Course-1	-	2	1	-	-	50	-	50	-	-	2	2
109308	CEP/FP	Community Engagement / Field Project	-	4	-	-	-	50	-	50	-	2	-	2
Total			11	12	3	200	300	225	75	800	11	5	4	20

Group	Course Code	MDM Courses - 1	Course Code	VEC Courses - 1	Course Code	EEM Courses – 1
A	170304A	Engineering Mathematics-III	173307	Universal Human Values	172306	Entrepreneurship Development
B	170404A	Artificial Intelligence	173407	Environmental Studies	172406	Business Economics

Course Code	Open Elective Course – 1	Course Code	Open Elective Course – 1
171305A	Intellectual Property Rights and Ethics	171405A	Introduction to Cyber Security
171305B	Renewable Energy		
171305C	Health, Care and Management Systems		
171305D	Smart City and Infrastructure		

Second Year B.Tech. Automation and Robotics
Curriculum Structure (2024 Pattern) Semester - IV

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
109401	PCC-5	Principles of Robotics	2	2	-	40	60	25	25	150	2	1	-	3
109402	PCC-6	Electrical Machines and Drives	2	-	-	40	60	-	-	100	2	-	-	2
109403	PCC-7	Electronics and Embedded Systems	2	-	-	40	60	-	-	100	2	-	-	2
170304/ 170404	MDM-2	Multi-Disciplinary Minor Course-2	2	-	-	40	60	-	-	100	2	-	-	2
171305/ 171405	OEC-2	Open Elective Course-2	3	2	-	40	60	25	25	150	3	1	-	4
172306/ 172406	EEM-2	EEM Course-2	-	-	2	-	-	50	-	50	-	-	2	2
173307/ 173407	VEC-2	Value Education Course-2	-	2	1	-	-	50	-	50	-	-	2	2
174408	AEC-2	Ability Enhancement Course-2	-	-	2	-	-	50	-	50	-	-	2	2
109409	VSEC-3	Vocational & Skill Enhancement Course-3	-	4	-	-	-	50	-	50	-	2	-	2
109410	PCC-L1	Industrial Electronics and Electrical Machines Laboratory	-	2	-	-	-	25	25	50	-	1	-	1
Total			11	12	5	200	300	275	75	850	11	5	6	22

Group	Course Code	MDM Courses – 2	Course Code	VEC Courses – 2	Course Code	EEM Courses – 2
A	170404A	Artificial Intelligence	173407	Environmental Studies	172406	Business Economics
B	170304A	Engineering Mathematics-III	173307	Universal Human Values	172306	Entrepreneurship Development

Course Code	Open Elective Course – 2	Course Code	AEC Course – 2	Course Code	VSEC Course – 3
171305A	Intellectual Property Rights and Ethics	174408	Foreign Language	109409	Robotics Modeling and Analysis Laboratory
171305B	Renewable Energy				
171305C	Health, Care and Management Systems	Course Code	Open Elective Course – 2		
171305D	Smart City and Infrastructure	171405A	Introduction to Cyber Security		

- **Summary of Credits and Total Marks:**

Semester	Credits	Marks
III	20	800
IV	22	850
Total	**42**	**1650**

• Definition of Credit :

The Under Graduate (U.G.) programmes will have credit system. The details of credit will be as follow. 1 Credit = 1 hour/week for lecture = 2 hours/week for practical = 1 hour/week for tutorial

- **Description of Various Courses:**

Type of Course	Description
PCC	Programme Core Course
MDM	Multidisciplinary Minor Course
OEC	Open Elective Course
EEM	Entrepreneurship / Economics / Management Course
VEC	Value Education Course
CEP/FP	Community Engagement Project / Field Project
VSEC	Vocational and Skill Enhancement Course (Skill Courses)
AEC	Ability Enhancement Course

Semester - III

Course Code: 109301	Course Name: Kinematics of Machinery	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Mathematics, Engineering Physics, Engineering Mechanics.

Course Objectives:

- To identify and analyze various types of kinematic chains, mechanisms and machine components.
- To apply graphical method to analyze displacement, velocity and acceleration in mechanisms.
- To apply analytical technique to synthesize the mechanisms
- To analyze the kinematics of gear pairs, velocity ratios, relative motion between mating gears.
- To implement automation systems as transfer mechanisms and automated assembly lines.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Demonstrate mechanisms in real life applications and calculate the degrees of freedom.

CO2: Analyze velocity and acceleration of mechanisms by graphical method.

CO3: Synthesize a four bar and slider crank mechanism by analytical method.

CO4: Apply fundamentals of gear theory as a prerequisite for gear design.

CO5: Analyze automation systems as transfer mechanisms and automated assembly lines**.**

Course Contents:

Unit-I: Fundamentals of Mechanisms **06 Hours**

Kinematic link, types of links, kinematic pairs, types of constrained motions, mechanism, machine, kinematic chain, types of kinematic chain, four-bar chain and its inversions, slider crank chain and its inversions, double slider crank chain and its inversions, types of joints, degree of freedom.

Unit-II: Analysis of Mechanisms: Graphical Method **06 Hours**

Velocity and acceleration analysis mechanisms by relative velocity method, instantaneous

center of velocity, Kennedy's theorem, angular velocity ratio theorem, analysis of mechanism by ICR method.

Unit-III: Synthesis of Mechanisms **06 Hours**

Steps in Synthesis: Type synthesis, number synthesis, dimensional synthesis, tasks of kinematic synthesis - path, function and motion generation (body guidance), precision positions, Chebychev spacing, mechanical and structural errors.

Analytical Synthesis: Three position synthesis of four-bar mechanism using Freudenstein's equation.

Unit-IV: Kinematics of Gears **06 Hours**

Gear: Basics, terminology, classification. **Spur Gear:** Terminology, law of gearing, involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity. **Helical:** Terminology, geometrical relationships, virtual number of teeth for helical gears. **Worm and Worm Wheel:** Terminology, geometrical relationships. **Bevel Gear:** Terminology, geometrical relationships.

Unit-V: Mechanisms in Automation Systems **06 Hours**

Cams and Followers: Introduction, classification of cams and followers, terminology of cam, displacement diagram for the motion of follower as uniform velocity, Simple Harmonic Motion (SHM), uniform acceleration and retardation motion, cycloid motion, cam profile construction for knife-edge follower and roller follower, cam jump phenomenon.

Automation: Introduction, types of automation. **Method of Work Part Transport:** Continuous transfer, intermittent or synchronous transfer, asynchronous transfer, different types of transfer mechanisms: linear transfer mechanisms and rotary transfer mechanisms. **Automated Assembly-Line:** Types, assembly line balancing buffer storages, automated assembly line for car manufacturing, artificial intelligence in automation.

Learning Resources:

Text Books:

1. Theory of Machines by S S Ratan Ed. III, (McGraw Hill Education (India) Pvt. Ltd.).
2. Theory of Machines and Mechanisms by J. J. Uicker, G. R. Pennock, J. E. Shigley, Edition V, International Student Edition, Oxford.
3. Theory of Machines by Bevan T, Edition III, (Longman Publication).

Reference Books:

1. Theory of Mechanism and Machines, Ghosh Malik (East-West Pvt. Ltd.).
2. Theory of Machines, Sadhu Singh (Pearson Education).
3. Theory of Machine, V.P. Singh, Dhanpatrai and Sons.
4. Automation, production systems and computer-integrated manufacturing, M.P.

Groover, Prentice-Hall of India Pvt. Ltd, New Delhi.

Web link for MOOC / NPTEL Links:

1. Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur. https://nptel.ac.in/courses/112104121/
2. Theory of Mechanism, Prof. Sujatha Srinivasan, IIT Madras https://nptel.ac.in/courses/112/106/112106270/
3. Kinematics of Mechanisms and Machines, Prof. Anirvan DasGupta, IIT Kharagpur. https://nptel.ac.in/courses/112/105/112105268/
4. Automation in Manufacturing, Prof. Shrikrishna N. Joshi, IIT Guwahati. https://onlinecourses.nptel.ac.in/noc22_me123/preview

List of Practicals:

Following practicals must be performed. Term work of the student is evaluated based on the completion of practical, assignments using drawing aids, and detailed industrial visit report.

Experiments

1. To make a model of any mechanism by using waste material by the group of 4 to 6 students and to give a presentation using PPTs.
2. To study and verify cam jump phenomenon.
3. To study manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.

Assignments using Drawing Aids: Graphical assignments on Half Imperial drawing sheet.

1. Identify mechanisms in real life and analyze for types and number of links, pairs, obtain degrees of freedom. Submit the sheet.
2. To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method.
3. To solve two problems on velocity analysis using the ICR method.
4. To draw conjugate profile for any general type of gear tooth.
5. To draw cam profile for any two problems with combination of various follower motion with radial and off-set cam.
6. To draw the layout of a linear transfer system used in automated assembly lines.
7. To draw a conceptual automated car manufacturing line.

Virtual Laboratory: Exploring experiments on kinematics of machinery using Virtual Laboratory. Write brief reports of using Virtual Laboratory to perform following assignment.

1. Mechanisms and Robotics - Quick Return Mechanism,

   http://vlabs.iitkgp.ernet.in/mr/index.htm

Industrial Visits: A compulsory industrial visit must be arranged to industries/ establishments

that involve automation and mechanization during the semester to provide awareness and understanding of the course. The Industrial Visit must preferably be to

1. Manufacturing industries with assembly-line automation.
2. Automobile Assembly Plant.
3. Air-conditioning manufacturing plant.
4. Sugar factory.
5. Bottle filling plants.

The student must submit a properly documented, detailed industrial visit report in his/her own words.

Course Code: 109302	Course Name: Materials and Mechanics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Physics, Engineering Mechanics, Engineering Mathematics.

Course Objectives:

- To impart fundamental knowledge of material science and engineering.
- To indicate the importance of heat treatment on structure and properties of materials.
- To acquire basic knowledge of stress & strain due to various types of loading.
- To determine Shear Force and Bending Moment and draw SFD & BMD for transverse loading.
- To determine bending, shear stress & torsional shear stress.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Determine mechanical properties using destructive and non-destructive testing of materials.

CO2: Analyze effect of alloying element & heat treatment on properties of ferrous & nonferrous alloy.

CO3: Calculate stress and strain developed on determinate and indeterminate members.

CO4: Determine Shear force and bending moment and draw SFD & BMD for various types of transverse loading.

CO5: Compute the bending stresses, shear stresses and Torsional stresses on a beam.

Course Contents:

Unit-I: Engineering Materials and Testing **06 Hours**

Material Classification: Ferrous, non-ferrous, polymers, ceramics, composites.Material properties relevant to robotic arms and chassis.

Destructive tests: Tensile, compression, impact, and hardness tests. Non-Destructive Tests: Dye Penetrant, Magnetic Particle, Ultrasonic, Radiography.

Unit-II: Alloying and Phase Diagrams **06 Hours**

Solid solution, Hume-Rothery rule, Iron-Carbon phase diagram. Heat treatment of steels:

annealing, normalizing, hardening and tempering. Heat treatment of tool steels. Surface hardening of steels - carburizing, nitriding, carbo-nitriding, induction method.

Unit-III: Simple Stresses and Strains **06 Hours**

Overview of material properties, concept of stress and strain, types of stresses and strains, interrelation between elastic constants, stresses and strains in determinate and indeterminate structures, homogeneous and composite bars under concentrated loads, Thermal stresses.

Unit-IV: Shear Force and Bending Moment Diagrams **06 Hours**

Introduction to SFD, BMD, and relationship between rate of loading, shear force and bending moment, SFD & BMD diagrams for simply supported and cantilever beams for Point load, UVL, UDL and couple, maximum bending moment and position of points of contra flexure.

Unit-V: Stresses in Machine Elements **06 Hours**

Bending Stresses: Theory of simple bending, flexural formula, and bending stress distribution diagram.

Shear Stresses: Shear stress distribution formula and distribution diagrams for common cross sections.

Torsion: Introduction to torsion on a shaft with application, torsion equation, torsion in stepped and composite shafts.

Learning Resources:

Text Books:

1. Material Science and Metallurgy for Engineers by Dr.V. D. Kodgire & S.V.Kodgire,Tata McGraw Hill, Ed. 46, 2021
2. Material science and Engineering an Introduction by W. D. Callister, Khanna Publication,Ed. 10, 2018
3. S. Ramamurtham, Strength of material, Dhanpat Rai Publication
4. R. K. Bansal, Strength of Materials, Laxmi Publication
5. S.S. Rattan, Strength of Material, Tata McGraw Hill Publication Co. Ltd.

Reference Books:

1. Material Science and Engineering by V. Raghvan,PHI Learning, Ed. 6, 2015
2. Introduction to Physical Metallurgy byS.H.Avner,Tata McGraw HillEd. 2, 2022
3. Egor. P. Popov, Introduction to Mechanics of Solids, Prentice Hall Publication
4. Beer and Johnston, Strength of materials, CBS Publication.
5. G. H. Ryder, Strength of Materials, Macmillan Publication.

Web link for MOOC / NPTEL Links:

1. https://www.youtube.com/playlist?list=PLyAZSyX8Qy5C8ciqBBlypbx91j4nowUbL
2. https://archive.nptel.ac.in/courses/112/107/112107147/#

List of Practicals:

1. Tension test for ductile material on a universal testing machine
2. Compression test for brittle material using a virtual laboratory.
3. Shear test of ductile material on universal testing machine.
4. Impact Test for Steel, Aluminum, Brass and Copper (Charpy/Izod).
5. Non-Destructive testing - Dye Penetrant Test/ Magnetic Particle test.
6. Jominy End Quench Test for hardenability.
7. Experimental verification of flexural formula in bending for simple supported beam.
8. Experimental verification of Torsion formula for circular bar.

Course Code: 109303	Course Name: Manufacturing Technology	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE :** 40 Marks **ESE :** 60 Marks

Expected Prerequisite Courses:

- Engineering Physics, Engineering Mathematics.

Course Objectives:

- To describe various casting methods, procedure and solidification rate aspects.
- To classify, explain, and compare the working principles of different joining processes.
- To analyze the various metal forming processes.
- To study various metal cutting operations, viz., turning, milling, drilling, etc
- To understand advanced machining processes.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Describe casting processes and their applications.

CO2: Discuss different joining processes and their characteristics.

CO3: Demonstrate various forming processes.

CO4: Select a suitable metal cutting operation based on the requirement.

CO5: Classify various advanced manufacturing processes.

Course Contents:

Unit-I: Casting Processes **06 Hours**

Introduction to casting processes, Types of patterns, pattern-making allowances, sand casting, gating system in casting, Estimation of solidification rate, shell moulding, investment casting, die-casting, centrifugal casting, and continuous casting. Cleaning and finishing of casting, defects and remedial measures in casting. Robotics applications in casting.

Unit-II: Joining processes **06 Hours**

Study of welding and allied processes, Arc welding, Gas welding, Tungsten Inert Gas welding (TIG), Metal Inert Gas Welding (MIG), resistance welding, ultrasonic welding, electron beam welding, laser beam welding, Soldering, brazing, Heat Affected Zone (HAZ) in Arc welding, Welding defects and quality, Robotic welding systems.

Unit-III: Forming Processes **06 Hours**

Introduction of forming processes. Concept of plastic deformation, Classification of material forming process, Rolling, forging, extrusion, sheet metal working processes, wire drawing,

Applications of Robots in Forming Processes.

Unit-IV: Mechanics of Metal Cutting **06 Hours**

Introduction to metal cutting, Turning, Milling, drilling Processes, Geometry of single-point cutting tool, Orthogonal and Oblique cutting processes, Chip formation, Types of chips, Tool Life, Factors affecting on tool life, Tool life equation of Taylor, Tool wear and its types. Introduction to CNC machining, Additive manufacturing.

Unit-V: Advanced Machining Processes **06 Hours**

Electric Discharge Machining (EDM), wire cut EDM, Abrasive Jet Machining (AJM), Electro Chemical Machining (ECM), Ultra Sonic Machining (USM), LASER Beam Machining (LBM), Plasma arc machining, Application of Robots in machining process.

Learning Resources:

Text Books:

1. A Text Book of Manufacturing Technology, R. K. Rajput, Laxmi Publications (p) LTD
2. A Text Book of Production Technology, P. C. Sharma, S.Chand Publications
3. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, 'Elements of Workshop Technology', Vol I, II, Media Promoters, ISBN-10: 8185099154
4. R.K Jain., Production Technology, Khanna Publishers, 2008, ISBN 81-7409-099-1. 4.

Reference Books:

1. Mikell P. Groover, 'Introduction to Manufacturing Processes', Wiley India
2. J.S. Campbell, 'Principles of Manufacturing Materials and Processes', Tata McGraw-Hill
3. Rao P.N., 'Manufacturing Technology, Foundry, Forming and welding', Tata McGraw-Hill Publishing, 2006, ISBN 0-07-463180-2.
4. V. K. Jain 'Advanced Machining Processes', Allied Publishers Pvt. Ltd., New Delhi, 2009.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/112104301
2. https://nptel.ac.in/courses/112107089
3. https://nptel.ac.in/courses/112105306
4. https://nptel.ac.in/courses/112104425
5. https://nptel.ac.in/courses/112103528

Course Code: 170304A	Course Name: Engineering Mathematics-III	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE : 40 Marks** **ESE : 60 Marks**

Expected Prerequisite Courses:

- Differential and Integral calculus, Differential equations of first order and first degree.

Course Objectives:

- To make the students familiarize with concepts and techniques in Ordinary Differential Equations, numerical methods, Laplace transform, Z-transform.
- To equip students with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Solve higher order linear differential equations using appropriate techniques.

CO2: Apply Laplace transform and Z-Transform to solve differential equations, difference equations.

CO3: Apply vector calculus concepts to analyze problems and solve system of linear equations by using numerical methods.

CO4: Analyze discrete and continuous random variables using Binomial, Poisson and Normal distributions.

CO5: Analyze data through hypothesis tests like Chi-square and *t*-tests.

Course Contents:

Unit-I: Linear Differential Equations **04 Hours**

Linear Differential Equations (LDE) of n^{th} order with constant coefficients, complementary function, particular integral by using shortcut methods.

Unit-II: Transforms **06 Hours**

Laplace Transform: Laplace Transform, Inverse Laplace Transform & their theorems, Applications of LT for solving linear differential equations.

Z – Transform: Z-transforms and its region of convergence, properties of Z-transform, inverse Z-Transforms and its properties, application of Z-transform to solve difference equations.

Unit-III: Vector Calculus and Numerical Methods **08 Hours**

Vector Differentiation: Scalar and vector fields, vector differential operator, gradient,

divergence & curl, solenoid, irrotational and scalar potential.

Vector Integration: Line integrals, surface integrals, Gauss's divergence theorem and Stoke's theorem (without proof).

Interpolation: Newton's forward interpolation, Newton's backward interpolation, Lagrange's interpolation.

Solution to System of Linear Simultaneous Equations:

Direct method: Determinant method, matrix inversion method, Gauss-Jordan method, Gauss-elimination method.

Iterative method: Gauss Jacobi, Gauss –Seidel method.

Unit-IV: Probability **06 Hours**

Introduction to probability, random variable, discrete random variable, continuous random variable, binomial distribution, Poisson distribution, normal distribution.

Unit-V: Sampling and Inference **06 Hours**

Testing of hypothesis, null hypothesis, alternate hypothesis, critical region, two types of errors, level of significance, Chi-square test for the goodness of fit, Student's t-test for single mean.

Learning Resources:

Text Books:

1. Higher Engineering Mathematics by B. V. Ramana (Tata McGraw Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication).

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig (Wiley Eastern Ltd.).
2. Advanced Engineering Mathematics by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics by Peter V. O'Neil (Thomson Learning).
4. Thomas' Calculus by George B. Thomas, (Addison-Wesley, Pearson).

Weblink for MOOC / NPTEL Links:

1. Advanced Probability Theory by Prof. Niladri Chatterjee, IIT Delhi https://onlinecourses.nptel.ac.in/noc25_ma04/preview
2. Transform Calculus and its applications in DE by Prof. Adrijit Goswami, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_ma56/preview
3. Numerical Methods by Prof. Ameeya Kumar Nayak, Prof. Sanjeev Kumar,IIT Roorkee https://onlinecourses.nptel.ac.in/noc25_ma83/preview

Course Code: 170404A	Course Name: Artificial Intelligence	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE : 40 Marks** **ESE : 60 Marks**

Expected Prerequisite Courses:

- Fundamentals of Programming Language.

Course Objectives:

- To introduce fundamental concepts of Artificial Intelligence (AI) and its real-world applications across various engineering domains.
- To explore problem-solving strategies using AI techniques such as search, logic, and decision-making.
- To familiarize students with the basics of machine learning and data-driven decision systems.
- To demonstrate how AI is used in engineering design, automation, prediction, and optimization.
- To enable students to appreciate ethical considerations and societal impact of AI in engineering.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the basic principles and scope of Artificial Intelligence and its relevance to different engineering disciplines.

CO2: Apply search algorithms for solving simple engineering problems.

CO3: Understand and differentiate between types of machine learning and data representations.

CO4: Identify and analyze AI applications in domains such as predictive maintenance, smart cities, automation, and control systems.

CO5: Recognize ethical, social, and professional issues in deploying AI solutions in engineering contexts.

Course Contents:

Unit-I: Introduction to Artificial Intelligence **06 Hours**

Definition and scope, history and evolution of AI, AI in daily life and industry, relevance of AI to different engineering disciplines, basics of intelligent agents and environments.

Unit-II: AI Problem Solving and Search Techniques **06 Hours**

Problem formulation and state space, Uninformed search (BFS, DFS), Informed search (Greedy, A*); **Use cases:** Path planning for robots, resource allocation in construction, fault detection in electrical circuits.

Unit-III: Fundamentals of Machine Learning **06 Hours**

Supervised vs Unsupervised learning vs Reinforcement Learning, concept of training, testing and validation. **Common algorithms:** Regression, k-NN, k-means, Introduction to neural networks, **Applications:** Quality control, load forecasting, image classification, Introduction to AI Tools (e.g., Python, scikit-learn, TensorFlow overview/ Excel / Google Colab).

Unit-IV: AI Applications in Engineering Domains **06 Hours**

AI in design and optimization (e.g., generative design), AI for predictive maintenance and diagnostics, smart manufacturing, building management systems and IoT, AI in traffic management and construction safety, AI in healthcare devices and embedded systems.

Unit-V: Ethical, Legal and Societal Aspects **06 Hours**

AI and Ethics: Bias, fairness, and transparency, data privacy and security concerns.

Social Impact of Automation: Job displacement, decision accountability. Responsible AI practices and guidelines, regulatory aspects in India and globally (brief overview).

Learning Resources:

Text Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B. Nair, ISBN: 9780070087705, Tata McGraw-Hill Education, 2009.
2. Introduction to Machine Learning, Ethem Alpaydin, ISBN: 9780262028189, MIT Press, 2014.
3. Machine Learning, Tom M. Mitchell, ISBN: 9780070428072, McGraw-Hill, 1997.

Reference Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, ISBN: 9780136042594, Pearson Education, 2010.
2. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, ISBN: 9781449369415, O'Reilly Media, 2016.
3. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, ISBN: 9780387848570, Springer, 2009.
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, ISBN: 9780262035613, MIT Press, 2016.

Weblink for MOOC / NPTEL Links:

1. Google AI Education
   https://ai.google/education/

2. MIT OpenCourseWare – Artificial Intelligence
   https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2020/
3. Coursera – AI For Everyone by Andrew Ng (Beginner Friendly)
   https://www.coursera.org/learn/ai-for-everyone
4. Microsoft Learn – AI Fundamentals
   https://learn.microsoft.com/en-us/training/paths/introduction-artificial-intelligence/
5. IBM SkillsBuild (Free Courses on AI & Data Science)
   https://skillsbuild.org/
6. Google Colab (for coding practice)
   https://colab.research.google.com/

Suggested In-Class Activities

Unit No.	Activity	Description
I	AI Around You	Group activity: Identify and present 5 real-life examples of AI in their domain (mechanical, civil, etc.).
II	Search Algorithm Simulation	Paper-based or Python/Excel simulation of BFS/DFS/A* for maze/pathfinding problems.
III	Hands-on with ML Tools	Use Google Colab to run a simple regression/classification example (k-NN or linear regression).
III	Model Demo with Data	Upload a dataset (e.g., student marks) and perform basic ML predictions in class.
IV	Domain Use Case Analysis	Groups present how AI is used in their engineering field (1 use case each).
V	Ethics Debate	Conduct a structured debate: *"Will AI lead to massive job loss in engineering?"*
V	AI Ethics Case Study	Review and discuss an AI failure (e.g., biased facial recognition, self-driving accidents).

Course Code: 171305A	Course Name: Intellectual Property Rights and Ethics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- --.

Course Objectives:

- To understand basics of intellectual property rights (IPR).
- To learn copyright, trademarks and industrial design.
- To inculcate the ethical behaviour in the personal and professional lives.
- To facilitate the holistic development (life and profession) of students.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the basics of intellectual property rights.

CO2: Learn the patent filing process.

CO3: Understand the copyright/trademark/industrial design and filing process.

CO4: Understand the importance of ethics in their personal and professional life.

CO5: Learn the workplace responsibilities and rights as an engineer in the industry**.**

Course Contents:

Unit-I: Introduction to IPR **08 Hours**

Concept of property, concept and relevance of IPR, importance of IPR in socio-economic development and technological innovation, prosecution of patent, patent infringement, geographical indications, patent search.

Unit-II: Contents of IPR **08 Hours**

Meaning of patent, concept of novelty, inventiveness and utility, inventions not patentable, process and product patents, prosecution of patent, patent infringement.

Patent search, IPR filing process and documents, IPR commercialization and portfolio management.

Unit-III: Copyrights and Trademarks **08 Hours**

Copyright: Meaning & scope, concept of originality.

Trademarks and Industrial Design: certification marks, property marks, well known marks, domain name protection.

Unit-IV: Ethics **08 Hours**

Concepts and principles, personal and professional ethics, emotional intelligence, code of conduct, roots of unethical behavior and ethics for engineers & managers.

Unit-V: Workplace Responsibilities and Rights **08 Hours**

Moral development, codes of ethics, ethical decision making, ethical dilemmas.

Learning Resources:

Text Books:

1. WeGo Library Foundation Book (2025): Top 16 Secrets of Wealth Creation by Patent
2. Prabuddha Ganguli, (2001): Intellectual Property Rights. Tata McGraw Hill.
3. Mayall, Industrial Design, McGraw Hill.

Reference Books:

1. W.R. Cornish, (2013): Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights. Sweet and Max Well London
2. Fernando AC (2018). Business Ethics and Corporate Governance (2nd Ed). Pearson, Education India
3. Martin MW & Schinzinger R (2005). Ethics in Engineering (4th Ed). McGraw Hill.

Web link for MOOC / NPTEL Links:

1. https://ipindia.gov.in/
2. https://onlinecourses.nptel.ac.in/noc22_hs04/preview
3. https://nptel.ac.in/courses/127105008

List of Practicals:

1. Search any five product or process recent patents from Indian patent website, prepare and give the presentation on it.
2. Prepare the patent filing draft of any one process patent.
3. Prepare the patent filing draft of any one product patent.
4. Demonstrate the trademark for any five industrial designs based on market survey
5. Case study on copyright filing.
6. Case study on trademark/industrial design filing.

Course Code: 171305B	Course Name: Renewable Energy	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks **PR + OR** : 25 Marks

Expected Prerequisite Courses:

- Engineering Physics, Engineering Chemistry, Engineering Mathematics.

Course Objectives:

- To understand the principle of renewable energy generation such as hydro, solar, wind and bio-mass energy.
- To identify potential of renewable energy.
- To understand working of technologies to harness renewable energy.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Describe the basics of renewable energy.

CO2: Explain the constructional details and working of hydro-electric power plant.

CO3: Describe the fundamentals and technology to harness solar energy.

CO4: Explain the wind energy conversion system.

CO5: Discuss the bio-energy conversion pathways.

Course Contents:

Unit-I: Introduction to Renewable Energy **08 Hours**

Energy scenario in the World, energy scenario in India, need of renewable energy, scenario of renewable energy generation in India and government policies, fundamentals of hydro, solar, wind, biomass, geothermal, tidal, ocean thermal, magneto hydro-dynamic and hydrogen energy.

Unit-II: Hydroelectric Energy **08 Hours**

Basics of hydrology, Hydroelectric Power Plant (HEPP): Classification, site selection, types of turbines, spillways, surge tanks, advantages and disadvantages, major HEPPs in India, hydroelectric energy scenario in India.

Unit-III: Solar Energy **08 Hours**

Terminology, solar radiation data, solar energy collectors, solar energy storage, power conditioning equipment, economics of solar photovoltaic power plant, advantages and

disadvantages of solar energy, solar energy scenario in India.

Unit-IV: Wind Energy **08 Hours**

Wind availability data, basic components of wind mills, aerodynamics and design of wind turbine, performance operating characteristics, wind solar hybrid power plants, cost economics, wind energy scenario in India.

Unit-V: Biomass Energy **08 Hours**

Biomass types and characterization, biomass energy potential in India, Biomass energy pathways – chemical and thermal, conversion technologies - digester and gasifier, biofuels, biomass energy scenario in India.

Learning Resources:

Text Books:

1. R.K.Rajput, Power Plant Engineering, Laxmi Publications New Delhi.
2. G. D. Rai, Energy Sources, Khanna Publications.

Reference Books:

1. B. H. Khan, Non-Conventional Energy Sources, Second Edition. Tata Mc-Graw Hill.
2. S P Sukhatme and J P Nayak, Solar Energy: Principles of Thermal Collection and Storage, McGraw-Hill Education, 2017.
3. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Alpha Science, 2002.
4. J. F. Manwell, J. G. McGowan and A. L. Rogers., Wind Energy Explained- Theory, Design and Application. John Wiley and Sons Ltd.
5. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier, 2013.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/103103207
3. https://nptel.ac.in/courses/108108078

Web References:

1. Website of International Energy Agency
   https://www.iea.org/energy-system/renewables
2. Website of Ministry of New and Renewable Energy
   https://mnre.gov.in/en/
3. India_2020_Energy_Policy
   https://iea.blob.core.windows.net/assets/2571ae38-c895-430e-8b62-bc19019c6807/India_2020_Energy_Policy_Review.pdf

List of Practicals:

1. Plotting of PV and IV curve of solar panel using simulation.
2. Finding Maximum Power Point Tracking (MPPT) of solar panel using simulation.
3. Design and component selection for solar photovoltaic power plant with net metering.
4. Measurement of wind speed using anemometer.
5. Visit to solar PV power plant / wind turbine power plant.
6. Visit to hydroelectric power plant / biomass power plant.
7. Case study on biomass digester or biomass gasifier and analysis of properties of products.
8. Case study on government policies on adoption of renewable energy.

Course Code: 171305C	Course Name: Health, Care and Management Systems	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Chemistry, Fundamentals of Electronics Engineering, Basic Electrical Engineering.

Course Objectives:

- To introduce the basics of human body systems relevant to healthcare.
- To understand common health issues and their engineering solutions.
- To explore biomedical instruments and hospital technologies.
- To gain awareness of digital healthcare systems and hospital management.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the structure and functions of key human body systems relevant to healthcare and diagnosis.

CO2: Identify common health issues and describe their causes and symptoms.

CO3: Apply principles and uses of basic biomedical instruments for diagnosis and patient monitoring.

CO4: Analyze the role of advanced medical devices and imaging systems in clinical decision-making and treatment.

CO5: Apply hospital management systems and digital health technologies like EHR, telemedicine, and emergency tracking in healthcare scenarios**.**

Course Contents:

Unit-I: Introduction to Human Body Systems **08 Hours**

Overview of Major Body Systems: Heart and blood circulation (Cardiovascular system), Breathing system (Respiratory system), Nervous system, Muscular system. Five senses. Working of eyes and ears. Kidney and its functions.

Unit-II: Common Health Problems and Causes **08 Hours**

Health Issues Related to: Heart: Cardiac arrest, high/low blood pressure, Brain: Neurological disorders, Eye and ear: Vision issues, hearing loss, Lungs: Respiratory problems, Muscles:

Movement disorders, Blood flow. Kidneys: Kidney failure, Bones: Fractures.

Unit-III: Basic Engineering Devices in Healthcare **08 Hours**

Electro-Cardiography (ECG), Blood pressure monitor, Electro-Encephalography (EEG), Eye tools: Visual Acuity, Ear tools: audiometer, Lung tools: Spirometer, Muscle activity: Electro-Myography (EMG), Blood flow meters, Dialysis machine (artificial kidney).

Unit-IV: Advanced Technologies in Hospitals **09 Hours**

Digital X-ray machine, Pacemaker, Defibrillator, Ventilator, Ultrasound imaging, Computer Tomography (CT scan), Magnetic Resonance Imaging (MRI), Robotic-assisted surgery.

Unit-V: Hospital Management System **07 Hours**

Patient registration process, Health records: paper-based vs. electronic, Software used in hospitals, Electronic Health Records, Telemetry and telemedicine, Emergency systems (e.g., ambulance tracking), Real-world examples of hospital IT systems.

Learning Resources:

Text Books:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill.
2. C. N. Chatterjee, Human Physiology (Vol 1 & 2), Medical Allied Agency.

Reference Books:

1. Leslie Cromwell, Biomedical Instrumentation and Measurements, Prentice-Hall of India.
2. John Enderle & Joseph Bronzino, Introduction to Biomedical Engg., Academic Press.
3. Anne Waugh & Allison Grant, Ross and Wilson Anatomy and Physiology in Health and Illness, Elsevier.

Web link for MOOC / NPTEL Links:

1. Biomedical Instrumentation https://nptel.ac.in/courses/108/105/108105101/
2. Human Anatomy and Physiology https://www.khanacademy.org/science/health-and-medicine
3. Coursera – Introduction to Medical Imaging https://www.coursera.org/learn/medical-imaging
4. Anatomy and medical illustration videos. https://www.youtube.com/@armandohasudungan
5. Simple demos of biomedical concepts. https://www.youtube.com/@BiomedicalEngineersTV/videos
6. WHO eLearning Resources https://openwho.org/

List of Practicals:

1. Measure your own blood pressure using a digital Sphygmomanometer/APP.
2. Record and analyze heart rate using a pulse sensor/App.
3. To study ECG waveform and understand its parts.
4. To study Spirometer and understand its waveforms
5. To study and understand EEG waveforms.
6. To study and understand EMG waveforms.
7. To study Audiometer and understand Audiogram.
8. Case study on Hospital Information Systems (any one): Patient Registration (using MS Excel), EHR, Telemedicne, Emergency Systems and Healthcare IT Tools.
9. Presentation / report on a visit to a nearby clinic, use of a Health App or study of a related healthcare facility.
10. Virtual Lab Experiments: https://bmi-iitr.vlabs.ac.in/

Course Code: 171305D		Course Name: Smart City and Infrastructure
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Basic of Computer Knowledge, Indian Knowledge System.

Course Objectives:

- To introduce the concept and components of smart cities, including infrastructure, technology and sustainability.
- To enable the students to apply the basic need and planning concept to solve various infrastructure problems such as transportation, water supply and waste management, etc.
- To apply emerging technologies such as IoT, GIS and data analytics in designing and developing smart city infrastructure solutions.
- To encourage critical thinking through case studies and real-world examples of smart city projects, focusing on challenges and best practices.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Describe the concept, features, and components of smart cities with relevant examples.

CO2: Demonstrate the structure and regulatory mechanisms of smart city development in context of Indian and international benchmarks.

CO3: Apply GIS and remote sensing techniques for spatial analysis and infrastructure planning in smart cities.

CO4: Relate smart transportation technologies and their role in improving urban mobility and sustainability.

CO5: Suggest smart solutions for urban water, air and waste management using IOT technologies.

Course Contents:

Unit-I: Introduction to Smart Cities **08 Hours**

Definition and key features of smart cities, smart infrastructure components, urban planning's role in smart cities, challenges and opportunities in smart city development, successful smart city case studies from around the World.

Unit-II: Planning and Development of Smart Cities **08 Hours**

Smart city mission of India, global standards and performance benchmarks, practice codes, smart city planning and development, financing smart cities development, governance of smart cities, SDG goals.

Unit-III: Applications of GIS and Remote Sensing **08 Hours**

Fundamentals of GIS and remote sensing, role of GIS in urban planning and development, spatial data analysis and visualization for smart cities, applications in infrastructure management: roads, utilities and land use.

Unit-IV: Smart Urban Transportation Infrastructure **08 Hours**

Smart transportation systems, Intelligent Transportation Systems (ITS): sensors and communication, AI and machine learning in traffic management, public transport integration with smart technologies, EV infrastructure and sustainable urban mobility, successful smart transportation project case studies.

Unit-V: Smart Technologies for Sanitation Infrastructure **08 Hours**

Water demand and supply planning in smart cities, smart water grids: real-time monitoring, IoT integration in water and sewer management, air quality management and smart solid waste management.

Learning Resources:

Text Books/Guidelines:

1. Smart Cities Mission, India: Localizing Sustainable Development Goals, UN-Habitat. MoHUA, GoI. 2023.
2. Smart Cities, Mission Statement & Guidelines, Ministry of Urban Development Government of India, June 2015.

Reference Books:

1. Role of Edge Analytics on Sustainable Smart City Development: Challenges and Solutions by G. R. Kanagachidambaresan.
2. Solving Urban Infrastructure Problems Using Smart City Technologies: Handbook on Planning, Design, Development, and Regulation by John R. Vacca.
3. Sustainable Smart Cities in India: Challenges and Future Perspectives (The Urban Book Series) by Poonam Sharma and Swati Rajput.
4. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony M. Townsend.
5. GIS for Urban and Regional Planning by Peter O'Connell.
6. Artificial Intelligence in the 21st Century by Stephen Lucci and Danny Kopec.
7. IoT for Smart Cities: Technologies, Big Data & Security by Zaigham Mahmood.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/ntr25_ed38/preview
2. https://www.edx.org/learn/urban-planning/world-bank-group-e-learning-course-on-smart-city?index=product&queryId=5033b061a1acb99dd13abd8a53491c99&position=1
3. https://www.coursera.org/learn/smart-cities

List of Practicals/Assignments:

1. Prepare a report and presentation on a selected Indian smart city.
2. Analyze and evaluate smart city governance structures and funding models, highlighting major strategies, strengths, and concerns.
3. Introduction to GIS and remote sensing in smart city planning
4. Prepare a case study report on how AI and Machine Learning are used for traffic congestion management in a smart city project.
5. Identify the applications for smart solid waste management with IoT.
6. Introduction to EPANET software and its application in smart city development.
7. Field visit at smart city project and prepare technical report.
8. Mini Project: Identify problems in the infrastructure facility of city and propose a smart solution for the identified problem.

Course Code: 172306	Course Name: Entrepreneurship Development	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Tutorial : 2 Hours/Week	**2**	**TW** : 50 Marks

Expected Prerequisite Courses:

- Professional Communication Skills.

Course Objectives:

- To equip to recognize the importance of entrepreneurship in economic and social development.
- To assist students in validating innovative business ideas.
- To inculcate principles of financial feasibility, revenue model, and funding options in an entrepreneurial context.
- To facilitate to pitch the business ideas effectively and develop a structured business plan.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the concept of entrepreneurship and its importance in economic and social development.

CO2: Identify, evaluate, and validate innovative business ideas using market research techniques.

CO3: Analyze startup funding options, revenue models, and financial feasibility of new businesses.

CO4: Demonstrate the ability to pitch business ideas effectively to potential stakeholders.

CO5: Develop a structured business plan incorporating all key aspects of entrepreneurship**.**

Course Contents:

Unit-I: Understanding Entrepreneurship **04 Hours**

Definition and importance of entrepreneurship, characteristics of successful entrepreneurs, types of entrepreneurs (innovators, imitators, social entrepreneurs, corporate entrepreneurs, etc.), entrepreneurial mindset and problem-solving approach, startup ecosystem in India – govt. Schemes (Startup India, Mudra, etc.).

Unit-II: Business Idea Generation and Validation **04 Hours**

Sources of business ideas (personal experience, market gaps, innovations, etc.), design thinking approach to problem solving, concept of ideation, prototyping and experimentation, feasibility

analysis: market feasibility, technical feasibility, financial feasibility.

Unit-III: Market Research and Business Model Canvas **04 Hours**

Introduction to market research – primary vs. Secondary data, competitive analysis and market segmentation, understanding customer pain points and buying behavior, business model canvas and lean startup approach.

Unit-IV: Startup Finance and Funding **04 Hours**

Introduction to startup funding (bootstrapping, angel investment, VC, IPO), revenue models and financial planning for startups, break-even analysis and risk management in startups.

Unit-V: Pitching and Business Prototyping **04 Hours**

Essentials of a good startup pitch, how to develop a prototype or Minimum Viable Product (MVP), how to persuade investors and customers.

Learning Resources:

Text Books:

1. Entrepreneurship Development and Small Business Enterprises – Poornima M. Charantimath. Pearson Publication.
2. Innovation and Entrepreneurship – Peter F. Drucker, Harper Business.
3. Startup Success: The Indian Way – Prachi Garg, Bloomsbury India.
4. Entrepreneurship: New Venture Creation – David H. Holt, Prentice Hall India

Reference Books:

1. Entrepreneurship: Theory, Process, and Practice – Donald F. Kuratko and T.V. Rao, Cengage India.
2. Make in India: The Road Ahead – I.K. Menon, Rupa Publications.

Web link for MOOC / NPTEL Links:

1. Steve Jobs' Stanford Commencement Speech. www.www.youtube.com/watch?v=Hd_ptbiPoXM.
2. How to Generate Business Ideas. www.onlinecourses.nptel.ac.in/noc21_mg63/preview
3. Business Model Canvas Explained. www.youtube.com/watch?v=z6-Ly8Bl4Hc
4. Basics of Startup Funding. www.razorpay.com/blog/business-banking/all-about-startup-funding/
5. How to Pitch a Startup Idea. www.onlinecourses.nptel.ac.in/noc25_ge11/preview..

List of Activities:

1. **Meet the Entrepreneur – Guest Lecture and Interview**: Arrange an interactive session with a local entrepreneur. Students will prepare interview questions, conduct discussions, and submit a report. Expected Outcome: Understanding real-world

entrepreneurial challenges and decision making. Case Study: Dhirubhai Ambani – The Entrepreneurial Journey.

2. **Idea Lab – Brainstorming and Idea Pitching:** Students will brainstorm ideas, assess feasibility, and pitch concepts. Expected Outcome: Enhanced creativity, ability to identify opportunities. Case Study: Airbnb's Pivot Story.
3. **Market Pulse – Conducting a Market Survey: S**tudents will conduct market surveys, analyse responses, and interpret insights. Expected Outcome: Understanding of market demand and consumer preferences. Case Study: Zomato's Market Entry Strategy
4. **Investor's Desk – Creating a Business Plan and Financial Projection:** Students draft a business plan with basic financial estimates. Expected Outcome: Understanding financial viability of a startup. Case Study: OYO Rooms – Funding Rounds
5. **Startup Shark Tank – Business Pitch Presentation:** Students prepare and present a business pitch to a jury. Expected Outcome: Confidence in pitching ideas and persuasive communication. Case Study: Shark Tank Success Stories.

Course Code: 172406	Course Name: Business Economics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Tutorial : 2 Hours/Week	**2**	**TW** : 50 Marks

Expected Prerequisite Courses:

- Professional Communication Skills.

Course Objectives:

- To equip students to recognize importance of economics and business decision-making.
- To assist students in applying demand, supply principles, and pricing strategies.
- To inculcate the understanding of cost–structure, profitability, and break–even points from the business perspective.
- To facilitate the students to understand the real-life business eco-system.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the role of economics in business decision-making and analyze real-world economic scenarios.

CO2: Apply demand and supply principles to determine market equilibrium and pricing strategies.

CO3: Analyze cost structures, profitability and break-even points in business operations.

CO4: Evaluate the impact of business cycles, inflation, and government economic policies on industries.

CO5: Develop pricing strategies based on competitive analysis and consumer demand**.**

Course Contents:

Unit-I: Basics of Business Economics **04 Hours**

Introduction to micro and macro-economics, concept of scarcity, choice and opportunity cost, role of economics in business decision making, real-world applications in Indian industries.

Unit-II: Demand, Supply and Market Equilibrium **04 Hours**

Law of demand and supply, elasticity of demand and its business implications, market equilibrium and price determination, case studies on demand forecasting.

Unit-III: Cost, Revenue and Profitability **04 Hours**

Types of costs – fixed, variable, marginal costs, break-even analysis and profit maximization strategies.

Unit-IV: Business Cycles and Economic Policies **04 Hours**

Understanding inflation, recession, boom cycles, impact of govt. policies on business and economy.

Unit-V: Pricing Strategies and Competition **04 Hours**

Pricing strategies – skimming, penetration, cost-based pricing, other pricing strategies, understanding market structures – monopoly, oligopoly and perfect competition.

Learning Resources:

Text Books:

1. Managerial Economics – D.N. Dwivedi, Vikas Publishing.
2. Business Economics – H.L. Ahuja, Publication by S. Chand.
3. Microeconomics for Business – Satya P. Das, Oxford University Press India.
4. Macroeconomics for Managers – Shankar Acharya, Sage Publications.

Reference Books:

1. Indian Economy – Ramesh Singh, McGraw Hill.
2. Economic Environment of Business – Veena Keshav Pailwar, PHI Learning.

Web link for MOOC / NPTEL Links:

1. Introduction to Business Economics – NPTEL Lecture by IIT Madras. https://nptel.ac.in/courses/130106118.
2. How Economic Principles Shape India's Startup Ecosystem" – Published in the Economic Times. https://economictimes.indiatimes.com/tech/startups/national-startup-day-2025-how-nine-years-of-policies-shaped-indias-startup-ecosystem/articleshow/117291674.cms?from=mdr
3. Law of Demand and Supply Explained with Real-Life Examples" – Dr. Vivek Bindra. https://www.youtube.com/playlist?list=PLOxBmXq4mdMOd3RQ3bAWxz8siZ4pnOtjI
4. How Patanjali Capitalized on Demand Elasticity to Dominate Indian FMCG Market" – Business Standard. https://www.business-standard.com/article/management/the-patanjali-effect-116020800204_1.html
5. Break-Even Analysis and Its Business Applications – Harvard Business Review. https://hbr.org/2014/07/a-quick-guide-to-breakeven-analysis
6. How Indian Airlines Manage Costs and Profit Margins – The Hindu Business Line. https://www.thehindubusinessline.com/economy/logistics/will-indian-aviation-market-turn-profitable-as-it-heads-towards-duopoly/article67453093.ece
7. Business Cycles Explained with Real-Life Examples – NPTEL Economics. https://www.investopedia.com/terms/b/businesscycle.asp

8. Indian Government's Response to Economic Slowdowns: A Policy Review – Economic Survey of India. https://www.indiabudget.gov.in/budget2024-25/economicsurvey/doc/echapter.pdf
9. Types of Market Structures and Their Business Implications – Investopedia. https://www.investopedia.com/terms/m/market.asp
10. Indian Government's Response to Economic Slowdowns: A Policy Review – Economic Survey of India. https://www.indiabudget.gov.in/budget2024-25/economicsurvey/doc/echapter.pdf.

List of Activities:

1. **Economic Detective – Identifying Economic Principles in Real Businesses:** Students analyze news reports to find economic applications. Expected Outcome: Understanding economic impact on business. Case Study: "How Amul Uses Economic Principles for Business Expansion" – Discusses pricing strategies, production decisions, and supply chain management.
2. **Local Market Analysis – Demand-Supply Survey:** Students visit local markets to analyse pricing and customer behavior. Expected Outcome: Real-world application of demand-supply principles. Case Study: "Why Uber Uses Surge Pricing: A Demand and Supply Analysis.
3. **Profit Calculator – Cost and Revenue Analysis:** Students analyze cost structures of local businesses. Expected Outcome: Practical understanding of business profitability. Case Study: How Swiggy and Zomato Optimize Costs and Pricing to Stay Profitable.
4. **Economic Trends Report – Analysing GDP and Policies:** Students analyse recent economic trends and policies. Expected Outcome: Awareness of macroeconomic factors affecting business. Case Study: "How the 2008 Global Financial Crisis Impacted Indian Startups.
5. **Competitive Pricing Challenge – Designing a Pricing Strategy:** Students set competitive prices for a product and justify pricing. Expected Outcome: Real-world pricing strategy application. Case Study: Why Jio's Pricing Strategy Disrupted the Indian Telecom Market.

Course Code: 173307	Course Name: Universal Human Values	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 2 Hours/Week **Tutorial** : 1 Hour/Week	**2**	**TW** : 50 Marks

Expected Prerequisite Courses:

- UHV-I (Student Induction Program).

Course Objectives:

- To equip students to recognize the harmony between "VALUES" and "SKILLS" for success and long-term fulfillment.
- To assist students to initiate an internal dialogue process to determine their true goals for their lives and careers.
- To inculcate principles of harmonious living within the family and society and to apply effective strategies for fostering trust, respect, and ethical values in interpersonal relationships.
- To facilitate the students to understand harmony at all the levels of human existence.
- To prepare students for the natural acceptance of human values and transform towards value based life.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explore a holistic vision of life, including the self and surroundings.

CO2: Recognize the co-existence of self, realize harmony, and comprehend the true happiness.

CO3: Apply strategies that foster harmony in family and society through effective communication and relationship-building to cultivate social well-being.

CO4: Execute self-regulations to mutually fulfilling human behavior and enriching interaction with nature to realize harmony.

CO5: Emphasize the implications of a holistic approach in terms of ethical human conduct, and transit towards value based life**.**

Course Contents:

Unit-I: Introduction to Value Education **06 Hours**

Overview of UHV-I (SIP) to highlight basic Universal human values truth (satya), peace (shanti), love (prem), nonviolence (ahimsa), scientific temper, citizenship values, and also life-skills; character, seva/service (social), education to be ethical, rational, compassionate, and caring, gainful and fulfilling employment.

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

Practice Sessions (Any Two):

1. **Self-Reflection** – Writing daily reflections on happiness, prosperity, and relationships.
2. **Natural acceptance** – Exploring natural acceptance.
3. **Human consciousness** – Exploring human consciousness
4. **Case Study Analysis** – Analyzing real-life scenarios related to materialism, relationships, and inner happiness.

Unit-II: Harmony in the Human Being **06 Hours**

Human beings are more than just the body, harmony of the self with the body, understanding myself as co-existence of the self and the body, understanding needs of the self and the needs of the body, understanding the activities in the self and the activities in the body.

Practice Sessions (Any Two):

1. **Self-Introductory** – Introduce yourself in detail, your goals and plans to achieve goals in life.
2. **Group Discussion –** How do you differentiate right and wrong? What have been your achievements and shortcomings in your life? Observe and analyze them?
3. **Need of Self and Body** – Explore the difference in need of self and body.
4. **Harmony in Self and Body** – Exploring harmony of self with the body.

Unit-III: Harmony in the Family and in Society **06 Hours**

Family Harmony and Well-Being, Trust – The Core Foundation of Relationships, Respect – Proper Acknowledgment and Appreciation, Ethical Values in Interpersonal Relationships, Comprehending Social Harmony, Aspirations for a Universal Human Order, Key Aspects of the Human Order, The Five Pillars of Human Organization.

Practice Sessions (Any Two):

1. **Role-Playing** – Exercise on Family Communication & Conflict Resolution,

2. **Group Discussion** – Exploring the feeling of trust and respect, trust-building activities in personal and professional relationships.
3. **Debate** – Debate on social harmony and universal human order.
4. **Human Goal** – Exploring Systems to fulfil Human Goal.

Unit-IV: Harmony in Nature/Existence 06 Hours

Understanding harmony in nature, self-regulation, and mutual fulfillment among the four orders of nature, realizing existence as coexistence, and holistic perception of harmony in existence.

Practice Sessions (Any Two):

1. **Orders of Nature** – Exploring the four orders of nature.
2. **Harmony in Nature** – Discussion on harmony in nature.
3. **Self-expression** – On Exploring co-existence in existence.
4. **Discussion** – Self-regulation and mutual fulfillment among the four orders of nature.

Unit-V: Implications of Holistic Understanding: A Look at Professional Ethics 06 Hours

Natural acceptance of human values, definitiveness of ethical human conduct, a basis for humanistic education, humanistic constitution and universal human order, competence in professional ethics, holistic technologies, production systems and management models-typical case studies, strategies for transition towards value-based life and profession.

Practice Sessions (Any Two):

1. **Discussion** – Exploring ethical human conduct.
2. **Humanistic Models** – in education.
3. **Case Studies** – Holistic technologies, production systems and management models.
4. **Transformation** – Steps of transition towards universal human order.

Learning Resources:

Text Books:

1. An Introduction to Indian Philosophy, Chatterjee, S.G. and Datta, D.M., University of Calcutta Press, 1960.
2. Manav Vyavahar Darshan, Nagraj A., Jeevan Vidya Prakashan, 3rd edition,2003.
3. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition),. ISBN 978-93-87034-47-1, Excel Books, New Delhi
4. Professional ethics and Human Values, R. S. Naagarazan, New age International publishers
5. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019.

ISBN 978-93-87034- 47-1.

6. The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G.
7. Harmony in the House: A Family Values Model by David A. Stallman. ECHOES Press -David A. Stallman; 1st edition (7 June 2013)
8. Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi, 2022.

Reference Books:

1. Human Values and Professional Ethics – R. R. Gaur, Rajeev Sangal, G.P. Bagaria, Excel Books, New Delhi
2. Vyavaharvadi Samajshastra, Nagraj,A., Jeevan Vidya Prakashan, 2nd edition, 2009.
3. Sociology & Economics for Engineers, Premvir Kapoor, Khanna Publishing House, New Delhi, 2018
4. Human Values, 2003, A. N. Tripathy, New age International Publishers
5. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
6. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
7. The Story of Stuff by Annie Leonard, Publisher Simon and Schuster
8. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi Public Affairs Press of Washington, D.C.
9. Small is Beautiful - E. F Schumacher. Publisher Harper Collins
10. Slow is Beautiful - Cecile Andrews, New Society Publishers
11. Economy of Permanence - J C Kumarappa, Sarva Seva Sangh Prakashan
12. Bharat Mein Angreji Raj – Pandit Sunderla, Prabhat Prakashan, New Delhi
13. Rediscovering India - by Dharampal, SIDH, Mussoorie, 2003.
14. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi, Navajivan Publishing House, Ahemadabad 380014, Gujarat, India
15. India Wins Freedom - Maulana Abdul Kalam Azad, published in 1988 by Orient BlackSwan
16. Vivekananda - Romain Rolland (English) Advaita Ashram, Calcutta
17. Gandhi - Romain Rolland (English) Shiva lal Agarwala & company, Agra.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/109104068
2. https://onlinecourses.nptel.ac.in/noc24_hs169/preview
3. https://archive.nptel.ac.in/content/syllabus_pdf/109104068
4. https://www.skillindiadigital.gov.in/courses/detail/d7db86f0-d2d8-42aa-a8c0-502467563b5a
5. https://uhv.org.in/

Tutorial and Term Work:

Term work shall be consists of following 08 activities from PART-A and 10 short reports from PART-B.

PART-A

1. **Digital Detox Experiment:** Avoiding social media and unnecessary digital distractions for a day and reflecting on mental clarity and happiness.
2. **Community Interaction Task:** Engaging with different social groups to understand diverse perspectives on happiness and prosperity.
3. **Health Awareness Program:** List down all your important desires. Observe whether the desire is related to Self (I) or the Body
4. **Role playing activity:** Make a chart to show the whole existence as co-existence. With the help of this chart try to identify the role and the scope of some of the courses of your study
5. **Family Dialogue Circle:** Participants engage in a structured conversation where they assume different family roles and practice active listening, empathy, and resolution strategies.
6. **Blindfold Trust Walk:** Participants pair up, with one guiding a blindfolded partner through obstacles to build trust and reliance.
7. **Reduce Waste:** Plastic / E-Waste / Medical/Hospital Waste/Pharmaceutical/Industrial Waste and its Management
8. **Value-based Life:** Strategies for Transition towards Value-based Life and Profession.

PART-B

Total 10 reports in brief, of practice session (02 from each unit).

Course Code: 173407	Course Name: Environmental Studies	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 2 Hours/Week **Tutorial** : 1 Hour/Week	**2**	**TW** : 50 Marks

Expected Prerequisite Courses:

- Basic Science.

Course Objectives:

- To describe the scope, importance and need for public awareness of environmental studies and natural resources.
- To explain the structure, function, and diversity of ecosystems and biodiversity, along with related case studies.
- To identify the causes, effects and control measures of various types of environmental pollution.
- To discuss major environmental and social issues, policies, and acts related to sustainable development.
- To observe and document environmental features, pollution sites, and ecosystems through field visits.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Describe the importance of environmental studies and the sustainable use of natural resources.

CO2: Explain the structure and function of ecosystems and the significance of biodiversity.

CO3: Identify various types of environmental pollution and their control measures.

CO4: Discuss key environmental issues, policies and their impact on society.

CO5: Observe and report environmental conditions and features through field activities**.**

Course Contents:

Unit-I: Introduction to Environmental Studies **06 Hours**

Definition, scope and importance, components of environment, Need for Public awareness, Natural Resources: Renewable and non- renewable resources: Natural resources and associated problems a) Forest b) Water c) Mineral d) Food e) Land f) Energy. Role of an individual in conservation of natural resources, use of resources for sustainable lifestyle.

Unit-II: Ecosystems and Biodiversity **06 Hours**

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers,

consumers and decomposer, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids, characteristic features, case study on forest ecosystem, aquatic ecosystem.

Biodiversity: Introduction – definition: genetic, species and ecosystem diversity, biogeographical classification of India, value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values, biodiversity at global, national and local levels, India as a mega-diversity nation, hotspots of biodiversity, threats to biodiversity, conservation of biodiversity, case study on any one hotspot of biodiversity.

Unit-III: Environmental Pollution **06 Hours**

Definition, cause, effects and control measures of different pollution: a) Air, b) Water, c) Soil, d) Noise, e) Thermal, f) Nuclear hazards, industrial pollution and control, solid waste management: control measures of urban and industrial waste, role of an individual in prevention of pollution. Case studies.

Unit-IV: Environment and Social Issues **06 Hours**

Environment from unsustainable to sustainable development, urban problems related to energy water conservation, rainwater harvesting, watershed management, resettlement and rehabilitation of people: its problems and concerns, case studies, environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies, wasteland reclamation, consumerism and waste products. Environment (protection) act, air (prevention and control of pollution) act, water (prevention and control of pollution) act, wildlife (protection) act, forest (conservation) act, issues involved in enforcement of environmental legislation, public awareness.

Unit-V: Field Wok **06 Hours**

Visit to water treatment plant/Municipal solid waste treatment plant and detail report on it.

Visit to an area to document environmental assets; river/forest/flora/fauna, etc.

Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.

Study of common plants, insects, birds and basic principles of identification.

Learning Resources:

Text Books:

1. Environmental Studies, Erach Bharucha, University Grants Commission, New Delhi
2. Environmental Science, Y. K. Singh, New Age International Publishers, 2006, .
3. Environmental Studies: From Crisis to Cure, Rajagopalan R., Oxford University Press,

USA, ISBN:9780199459759, 0199459754.
4. A text book of Environmental Science, Shashi Chawla, Tata Mc Graw-Hill New Delhi
5. A Text Book of Environmental science, Arvind Kumar, APH Publishing New Delhi.

Web link for MOOC / NPTEL Links:

1. Challenges to Sustainable Development: https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html
2. NPTEL course on sustainable development: https://nptel.ac.in/courses/109105190
3. Swayam Course on Environmental studies (Natural Resources, Biodiversity and other topics): https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
4. NPTEL course on environmental studies which encompasses SDGs, Pollution, Climate issues, Energy, Policies and legal framework: https://onlinecourses.nptel.ac.in/noc23_hs155/preview
5. SWOT analysis of Biodiversity: https://www.cbd.int/development
6. India's Strategies to progress across the SDGs.: https://sustainabledevelopment.un.org/memberstates/india
7. IGNOU's Initiative for online study material on Environmental studies: https://egyankosh.ac.in/handle/123456789/61136
8. IGNOU's Initiative for online study material on sustainability: https://egyankosh.ac.in/handle/123456789/50898
9. United Nation's website mentioning Sustainability goals: https://sdgs.un.org/goals
10. Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques: http://www.greenbeltmovement.org/what-we-do/tree-planting-for-watersheds

List of Activities:

Part-A: Assignments

1. Study and report on the role of individuals in conserving natural resource or engineering material.
2. Research and write a case study on one biodiversity hotspot in India. Include location, species richness, threats, and conservation efforts.
3. Choose one type of pollution (e.g., air or water or soil) and illustrate/analyse its causes, effects, and possible control measures in your city or town.
4. Prepare a presentation on any one issue: global warming, climate change, acid rain, or ozone depletion. Include current data and case studies.

Part-B: Field Work

5. Visit a water treatment plant or municipal waste treatment plant. Submit a detailed report with process description and photos/diagrams.
6. Visit to an area to document environmental assets; river/forest/flora/fauna, etc.
7. Report on a local polluted site – Urban/Rural/Industrial/Agricultural.
8. Study of common plants, insects, birds and basic principles of identification.

Part-C: Project/Activity

9. Branch-specific environmental studies/sustainability related Project/Activity.

Part-D: Report

10. Document your active participation in an environmentally friendly or sustainability-related activity, highlighting your role, the engineering relevance, and the impact of the initiative on promoting sustainable practices.

Course Code: 109308	Course Name: Community Engagement / Field Project	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 4 Hours/Week	**2**	**TW** : 50 Marks

Expected Prerequisite Courses:

- Professional Communication Skills, Programming and Problem Solving.

Course Objectives:

- To enhance the quality of teaching learning by bridging the gap between theory and practice through community engagement.
- To promote strong interactions between educational institutions and local communities for detection and solution of real-life problems.
- To create awareness about social responsibility to develop empathy for complex global challenges.
- To recognize the need for research and innovations in collaboration with society through community-based research methods.
- To catalyze the acquisition of values of public service and inculcate citizenship among the students.
- To involve educational institutions with local communities in order to make the curriculum, courses, and pedagogies more appropriate to achieve the goals of national development.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explore relevance between theory and practice through community-based problem learning.

CO2: Identify real-life socio-technical problems and develop the solution.

CO3: Implement a wisdom of empathy and social responsibility to meet complex global challenges.

CO4: Develop innovative ideas in collaboration with society through community-based research methods.

CO5: Analyze the need of research projects and develop a plan for betterment of public service values through active citizenship**.**

Course Contents:

A community engagement / field project is essential for second-year engineering students as it

bridges the gap between theoretical knowledge and real-world application. At this stage, students have gained foundational technical skills, and engaging with the community allows them to apply these skills to address practical challenges faced by society. It fosters a sense of social responsibility, encouraging students to consider the human and environmental impact of engineering solutions. Moreover, such projects help develop vital soft skills like communication, teamwork, and problem-solving, as students interact with diverse groups and learn to explain complex ideas in simple terms. By working on real-life issues, students also enhance their creativity and innovation, preparing them for future professional roles while contributing positively to their communities.

Guidelines for Conduction:

1. Formation of groups: 4 to 5 students /group.
2. Identification of one student representative for each class (if required).
3. Identification of communities (sectors / villages / nearby vicinity) as per the students' skills under respective departments.
4. Collection of different ideas or real-world problem statements from students through any open platform (Google forms / spreadsheets / handwritten applications).
5. Allocation of groups to an identified community (sectors / villages / nearby vicinity).
6. Allocating a faculty / mentor to a group. It is expected that a mentor can get assigned to a maximum three groups.
7. Students will be allowed to visit communities (sectors / villages / nearby vicinity) once in a week with prior permission.
8. Mentors can monitor field work and progress of projects through worksheets circulated by the coordinator.
9. Coordinator will keep a record of spreadsheets / reports / evaluation sheets.
10. Mentors are expected to approve the real-world problem and to encourage students to provide some solution / representation of a problem / volunteer-ship to any activity conducted by government / responsible authorities.
11. Mentors will collect all the project reports submitted by each group.

Guidelines for Evaluations:

1. Evaluation to be done based on the active participation of the student and marks could be awarded. For the community engagement project each student must get engaged and the coordinator / mentor must evaluate the projects / groups as well as the individual student twice in a semester. Mid-term evaluation must be done internally while end semester evaluation will be done by domain experts in specific domains or any other expert in the field. The average of these two evaluations will be considered as final

evaluation.

2. Students must represent a problem through power point presentations / posters / reels / short movies or any other effective media.
3. Project report shall be submitted by each group. Other than these, any required innovative process to make CEP effective and easy learning for students should be incorporated.

Guidelines for Students:

1. Community Engagement / Field Project is an opportunity for students to step out of their comfort zone, use knowledge, energy and creativity to contribute meaningfully to society.
2. It is an opportunity to discover the human side of engineering. Project reports shall be submitted by each student/group of students. All the students are expected to follow the phase wise instructions given by their CEP Coordinator / mentor.

Learning Resources:

Reference Books:

1. James Jacob W., Stewart E. Sutin, John C. Weidman, John L. Yeager, 2015, A Community Engagement in Higher Education: Policy Reforms and Practice, Sense publisher.
2. Jane Krauss, Suzanne K. Boss, Thinking Through Project-Based Learning: Guiding Deeper Inquiry.
3. John Larmer and Suzie Boss, Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences.
4. John Larmer, John R. Mergendoller, and Suzie Boss, 2013, Setting the Standard for Project Based Learning, Corwin Press.
5. Suzie Boss, Jane Krauss, Leslie Conery, Reinventing Project-Based Learning: Your Field Guide to Real-World Projects in the Digital Age, 2007, Int'l Society for Tech. in Education.
6. Judyth Sachs, Lindie Clark, 2017, Learning Through Community Engagement Vision and Practice in Higher Education, Springer Singapore.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/ugc25_ge01/preview.
2. https://www.uvm.edu/sites/default/files/community_engagement_handout.pdf

Semester - IV

Course Code: 109401	Course Name: Principles of Robotics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Mechanisms and their Application, Introduction to Manufacturing, Matrices, Vectors, Electrical Technology, Industrial Electronics, Mathematics.

Course Objectives:

- To understand the basic concepts and applications of robotics.
- To study different types of robot end effectors used in industries.
- To learn about robot sensors and their functions.
- To understand robot drive systems and control methods.
- To introduce basic mathematical modeling of robots.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the basic principles and components of robots.

CO2: Identify different types of end effectors and their uses.

CO3: Describe various sensors used in robots.

CO4: Explain robot drive systems and control systems.

CO5: Understand basic mathematical modeling and kinematics of robots.

Course Contents:

Unit-I: Fundamentals of Robotics **06 Hours**

Historical development of robotics, definitions of industrial robot, type and classification of robots, laws of robotics, robot configurations, robot components, robot degrees of freedom, work volume and work envelope, robot joints and symbols, robot coordinates, work cell control, robot performance- resolution, accuracy, repeatability, dexterity, compliance, RCC device, applications.

Unit-II: End Effectors **06 Hours**

Grippers, mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers; two-fingered and three-fingered grippers; internal grippers and external grippers; advanced 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.

Unit-III: Robot Sensors **06 Hours**

Transducers and sensors, sensors in robotics, principles and applications of the following types of sensors- proximity sensors, photo electric sensors, position sensors: piezo electric sensor, LVDT, resolvers, encoders, absolute and incremental: optical, magnetic, capacitive, pneumatic position sensors, range sensors: range finders, laser range meters, touch sensors, force and torque sensors, safety sensor: light curtain, laser area scanner, safety switches, machine vision.

Unit-IV: Robot Drive and Controls Systems **06 Hours**

Pneumatic drives, hydraulic drives, mechanical drives, electrical drives, D.C. servo motors, stepper motors, A.C. servo motors, BLDC-salient features, applications, micro actuators, selection of drive, power transmission systems for robots, motion conversion. Types of controllers, closed-loop control, second-order linear systems and their control, control law of partitioning, and trajectory-following control.

Unit-V: Mathematical Modeling of a Robot **06 Hours**

General mathematical preliminaries on vectors & matrices, link equations and relationships, direct kinematics, coordinate and vector transformation using matrices, rotation matrix, inverse transformations, composite rotation matrix, homogeneous transformations, robotic manipulator joint coordinate system, inverse kinematics of two joints, DH parameters, Jacobian transformation in robotic manipulation.

Learning Resources:

Text Books:

1. Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta, Industrial Robotics, Technology, Programming & Applications, Tata McGraw Hill Education Pvt. Ltd., New Delhi
2. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill.
3. Groover M.P.-Automation, production systems and computer integrated manufacturing- Prentice Hall of India.

Reference Books:

1. S. B. Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.
2. Mikell P. Groover, Automation, Production Systems & Computer Integrated Manufacturing, PHI Learning Pvt. Ltd., New Delhi, ISBN:987-81-203-3418-2, 2012
3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
4. R K Mittal & I. J. Nagrath, Robotics and Control, McGraw-Hill Publication, 2015.
5. Mike Wilson, Implementation of Robotic Systems, ISBN: 978-0-124-04733-4, Griha

Prakashan, Pune, Ed. I, 2022.

Web link for MOOC / NPTEL Links:

1. www.roboanalyzer.com
2. https://onlinecourses.nptel.ac.in/noc19_me74/preview
3. https://onlinecourses.nptel.ac.in/noc20_de11/preview

List of Practicals:

1. Identify and select sensors such as IR sensors, Proximity Sensor, Ultrasonic Sensor, White line sensor, Temperature Sensor, Touch sensor, Tilt Sensor, Accelerometer, Gyroscopic Sensor, etc. based on the given application
2. Identify and select Actuators and related hardware such as DC motor, Servo motor, Stepper Motor, Motor drivers based on application
3. Demonstration of various robotic configurations using an industrial robot
4. Design and selection of Gripper / End effector
5. One Industrial visit for Industrial robotic application
6. Choose the right robot for the given manufacturing and non- manufacturing applications.

Course Code: 109402	Course Name: Electrical Machines and Drives	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE** : 40 Marks **ESE** : 60 Marks

Expected Prerequisite Courses:

- Basic Electrical Engineering, Engineering Physics.

Course Objectives:

- To understand the fundamentals of electrical machines.
- To study DC and AC motors used in automation.
- To learn about working and controlling motors.
- To understand special-purpose motors.
- To apply motor drives in robotics.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the basics of electrical machines.

CO2: Describe the construction and working of brushed and brushless DC motors.

CO3: Understand the working principal and applications of 3 phase induction motors.

CO4: Identify suitable special purpose motors for robotics and automation applications.

CO5: Apply various speed control techniques to AC and DC motors.

Course Contents:

Unit-I: Fundamentals of Electrical Machines **06 Hours**

Introduction to electrical machines, classification of machines, basic electromagnetic principles, magnetic circuits, Faraday's laws of electromagnetic induction, force and torque production, constructional features of electrical machines (stator, rotor, windings), generators and motors, basics of transformers, losses and efficiency, EMF generation, and machine ratings.

Unit-II: DC Machines **06 Hours**

Construction, working principle, types of DC motors (series, shunt, compound), characteristics, speed control methods, and applications.

Unit-III: Induction Motors **06 Hours**

Construction, types of rotors, working principle and rotating magnetic field, synchronous speed, slip, torque equations, torque-speed/slip characteristics, power flow stages, speed

control methods, starting methods, braking methods, applications of induction motors in robotics and industrial automation system.

Unit-IV: Special Purpose Motors **06 Hours**

Construction, working, characteristics, speed control and applications for; Single phase induction motors, Stepper motor, Servo motor, PMSM (Permanent Magnet Synchronous Motor), switched reluctance motors, Linear motors, Universal motor, speed and position control techniques, applications of special purpose motors in robotics, automation and control systems.

Unit-V: Motor Drives and Control **06 Hours**

Components of motor drive systems, types of motor drives, power electronic converters used in drives, closed-loop and open-loop control systems, PWM (Pulse Width Modulation), VFD (Variable Frequency Drive), selection of motors for industrial applications and applications of motor drives in robotics and automation systems.

Learning Resources:

Text Books:

1. V. K. Mehta - Principles of electrical machines, S. Chand publications.
2. B. L. Theraja - Electrical technology, volume-II, AC and DC machines, S. Chand publications.
3. Nagrath & Kothari – Electrical Machines, by McGraw Hill Education.
4. G.K. Dubey – Fundamentals of Electric Drives, by Narosa Publishing House.

Reference Books:

1. P.S. Bimbhra – Electrical Machinery, by Khanna Publishers
2. Vedam Subrahmanyam – "Electric Drives: Concepts and Applications", by McGraw Hill Education
3. M.D. Singh and K.B. Khanchandani - "Power Electronics" by McGraw Hill Education.

Weblink for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ee24
2. https://nptel.ac.in/courses/108104140
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ee94

Course Code: 109403	Course Name: Electronics and Embedded Systems	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week	**2**	**CCE** : 40 Marks **ESE** : 60 Marks

Expected Prerequisite Courses:

- Basic Electrical Engineering, Engineering Physics, Fundamentals of Programming.

Course Objectives:

- To provide fundamental knowledge of analog and digital electronics required for automation and robotic applications.
- To develop understanding of microcontrollers and Arduino-based embedded systems for intelligent automation.
- To enable students to interface sensors, actuators, and communication modules with embedded platforms.
- To develop programming and hardware integration skills required for robotics and industrial automation.
- To introduce advanced embedded technologies, Industry 4.0 concepts, and IoT-enabled robotic systems.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply analog and digital electronic concepts to design basic electronic circuits used in automation and robotic systems.

CO2: Develop embedded applications using microcontrollers and Arduino programming concepts.

CO3: Interface sensors, actuators, and peripheral devices with embedded systems for automation applications.

CO4: Design intelligent robotic and automation solutions using communication protocols and real-time embedded control.

CO5: Analyze advanced embedded technologies and Industry 4.0 concepts for modern robotic and smart manufacturing systems.

Course Contents:

Unit-I: Analog Electronics Fundamentals **06 Hours**

Transistors and Switching Devices (BJT, MOSFET), Relay driving circuits, Optocoupler

basics, OPAMP based Comparator circuits, Signal conditioning basics, Sensor signal amplification. Boolean algebra basics, Combinational circuits: Multiplexer and Decoder, Sequential circuits: Flip-flops.

Unit-II: Microcontroller and Arduino UNO Programming 06 Hours

Embedded system Fundamentals (architecture, Characteristics, Classification, Hardware, Software), Microcontroller Architecture of 8051 & Arduino UNO, Arduino IDE and it's programming (Variables and data types, Operators and control statements, Delay generation, I/O programming, PWM generation), I/O devices interfacing with Arduino (LED, Buzzer, Switch, Relay, LCD).

Unit-III: Sensors, Actuators and Embedded Interfacing 06 Hours

Sensor characteristics, Analog and digital sensors for Automation and Robotics (Temperature, Ultrasonic, IR, PIR, Gas and humidity), Analog-to-digital conversion, ADC in Arduino. Actuators and Motor Control (DC, Servo, Stepper, L293D and motor control), Embedded monitoring systems (Line follower, Obstacle avoidance, Automatic lighting, Smart parking, etc), communication interface (UART, I2C, SPI, Bluetooth, Wi-Fi module).

Unit-IV: Embedded System Design 06 Hours

Embedded design flow, Requirement analysis, Hardware-software co-design, Prototype development, Testing and debugging., Real-time concepts, , Hard and soft real-time systems, Task scheduling basics, Embedded IoT architecture, Cloud monitoring concepts, Industrial automation basics, Human-machine interface basics, Safety considerations in robotic systems.

Unit-V: Advanced Embedded Technologies for Robotics 06 Hours

Industry 4.0 Fundamentals: Evolution of industrial revolutions, Smart manufacturing systems, Cyber-physical systems, Digital twins basics, Smart factories. Industrial Communication and Networking: Industrial IoT, MQTT protocol basics, Wireless sensor networks, Cloud computing in automation, Edge-cloud integration, Collaborative robots, Smart sensors and actuators, Future trends in embedded robotics.

Learning Resources:

Text Books:

1. Floyd, Thomas L. Electronic Devices. Pearson.
2. Raj Kamal. Embedded Systems: Architecture, Programming and Design. McGraw Hill.
3. Monk, Simon. Programming Arduino: Getting Started with Sketches. McGraw Hill.
4. Michael Margolis. Arduino Cookbook, SPD O'REILLY.

Reference Books:

1. Jonathan Valvano. Embedded Systems: Real-Time Interfacing to ARM Cortex-M.
2. Muhammad Ali Mazidi. The 8051 Microcontroller and Embedded Systems.
3. Morgan Quigley. Programming Robots with ROS. O'Reilly Media..

4. Kenneth J. Ayala, 'The 8051 Microcontroller Architecture, Programming and Applications', Cengage Learning, 3rd Edition.
5. Ajay Deshmukh, "Microcontrollers Theory and Applications", TATA McGraw Hill, 4th Edition.

MOOC / NPTEL/YouTube Links:

1. https://nptel.ac.in/courses/117/104/117104072/
2. https://nptel.ac.in/courses/108/105/108105102/
3. https://nptel.ac.in/courses/108105132

Course Code: 171405A		Course Name: Introduction to Cyber Security
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Computer & Programming, Operating System, Basic concept of Networks.

Course Objectives:

- To develop an understanding of the fundamental concepts, issues, and challenges in the field of cyber security.
- To create awareness about various types of cyber offenses, their legal remedies, and the procedures for reporting such crimes.
- To sensitize students to privacy and security concerns on social media and promote responsible usage through knowledge of legal aspects and best practices.
- To familiarize students with e-commerce and digital payment systems, including RBI guidelines and preventive measures against online frauds.
- To enable students to understand and apply basic security practices and tools for safeguarding computers and mobile devices.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the architecture, communication and governance of cyberspace and web technologies.

CO2: Identify and relate specific cybercrime incidents to relevant provisions of the IT Act 2000.

CO3: Apply basic practices to ensure privacy and security on social media platforms.

CO4: Apply security practices and legal guidelines to ensure safe E-Commerce and digital payment systems.

CO5: Demonstrate configuration and management of secure digital devices and tools**.**

Course Contents:

Unit-I: Introduction to Cyber Security **08 Hours**

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Internet

infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

Unit-II: Cyber Crimes and Cyber Law **08 Hours**

Cybercrime- Classification, Common Cybercrimes, Cybercriminals modus-operandi, reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of Cybercrime, IT Act 2000 and its amendments, Cybercrime and offences, Organisations dealing with Cybercrime and Cyber security in India.

Case Study: WannaCry Ransomware Attack- A Global Wake-Up Call.

Unit-III: Social Media Overview and Security **08 Hours**

Introduction to social networks, social media: Types, platforms, monitoring, hashtag, viral content, marketing, privacy, challenges, opportunities and pitfalls in online social networks, security issues related to social media, flagging and reporting of inappropriate content, laws regarding posting of inappropriate content, best practices for the use of social media.

Case Study: WhatsApp Spyware incident, Facebook–Cambridge Analytica Data Harvesting Scandal.

Unit-IV: E-Commerce and Digital Payments **08 Hours**

Commerce Basics: Definition, components, security elements, and threats, E-commerce security best practices. **Digital payments**: Introduction, components and stake holders, modes of digital payments, digital payments related common frauds and prevention. RBI Guidelines on digital payments and customer protection. Relevant provisions of Payment Settlement Act, 2007. **Case Study:** Cosmos Bank Cyber Attack.

Unit-V: Digital Devices Security, Tools and Technologies **08 Hours**

End Point device and mobile security, password policy, security patch management, data backup, management of third-party software, device security policy, cyber security best practices, host firewall and Antivirus - Significance & management, Wi-Fi security, configuration of basic security policy and permissions. **Case Study:** The Pegasus Airlines.

List of Practical / Assignments: (Guidelines for course teacher)

- The course instructor should design assignments that reflect essential cybersecurity principles and consider students' level of familiarity with digital tools and platforms.
- Assignments must reflect current cyber threats, technologies, laws and best practices followed in the industry.
- Assignments should be based on real-life cyber incidents, case studies and practical security problems.
- Practical demonstration tasks such as identifying vulnerabilities, analyzing cybercrime scenarios, or applying security controls in digital payment system. Study of social media platforms, should be included to improve readiness for future projects / professional roles.

Learning Resources:

Text Books:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives Sumit Belapure & Nina Godbole, Wiley India Pvt. Ltd.
2. Cyber Crime and Laws Dr. Santosh Kumar & Dr. Gagandeep Kaur, Whitesmann Publishing.
3. Cyber Crime Impact in the New Millennium R. C. Mishra, Authors Press.
4. Fundamentals of Network Security E. Maiwald, McGraw Hill.

Reference Books:

1. Network Security Bible (2nd Edition) Eric Cole, Ronald Krutz, James W. Conley, Wiley India Pvt. Ltd.
2. Security in the Digital Age: Social Media Security Threats and Vulnerabilities Henry A. Oliver- Pearson.
3. Electronic Commerce Elias M. Awasd, Prentice Hall of India Pvt Ltd.
4. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Pub.
5. Cryptography and Network security, Atul Kahate, The McGraw Hill, second Edition.

Web link for MOOC / NPTEL Links:

1. Cyber Security and Privacy by Prof. Saji K Mathew, IIT Madras
   https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. Practical Cyber Security for Practitioners by Prof. Sandeep K. Shukla, IIT Kanpur
   https://onlinecourses.nptel.ac.in/noc25_cs120/preview
3. Introduction To Cyber Security by Dr. Jeetendra Pande, Uttarakhand OU, Haldwani.
   https://onlinecourses.swayam2.ac.in/nou24_cs04/preview
4. Cyber Laws by Dr Vishal Goyal, Professor in Computer Science, Department of Computer Science, Punjabi University, Patiala.
   https://onlinecourses.swayam2.ac.in/cec24_cs14/preview

Important DOs and DON'Ts in Cyber Security:

DOs

- Use strong passwords and enable two-factor authentication on all accounts.
- Keep your devices, apps, and antivirus updated regularly.
- Verify sources before clicking links or downloading files; report phishing emails.
- Backup important data and secure your devices.
- Follow ethical and legal practices; understand IT Act and cyber laws.

DON'Ts

- Never share passwords, OTPs, or sensitive banking information.
- Do not click on suspicious links or open unknown attachments.
- Never attempt hacking or bypass security without permission.
- Do not overshare personal information on social media or online platforms.
- Do not ignore suspicious activity - report it through official channels.

Course Code: 174408	Course Name: Foreign Language	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Tutorial : 2 Hours/Week	**2**	**TW** : 50 Marks

Expected Prerequisite Courses:

- Professional Communication Skills.

Course Objectives:

- To develop Foundational Language Skills, Enhance Communication Competence, Promote Multilingual Proficiency, Support Career and Academic Opportunities, Boost Confidence and Motivation in Language Learning.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Learn the basic phonetics, alphabets and sounds of the selected foreign language.

CO2: Interpret and use everyday vocabulary to manage simple social interaction.

CO3: Form simple sentences using basic grammatical structures and sentence patterns.

CO4: Participate in simple conversations and everyday communication situations relevant to academic, social and professional contexts.

CO5: Demonstrate cultural awareness and appropriate language behaviour to facilitate global and cross-cultural interactions**.**

Course Guidelines:

1. **Course Selection**: Students will choose one foreign language course from the provided basket, based on their interest and career aspirations.
2. **Course Allocation**: Each student will be allotted their selected language course, ensuring dedicated participation and meaningful learning.
3. **Expert Instruction**: Courses will be taught by qualified language instructors using an engaging mix of activities, group discussions, cultural presentations, and lectures, either in-person or online.
4. **Activity Documentation**: Students must prepare and submit a hard copy report of the language-learning activities they participated in, along with a certificate of participation from the instructor or institution.
5. **Evaluation Criteria**: Assessment will focus on the completeness, quality, and reflection demonstrated in the submitted activity report.
6. **Mentorship**: Faculty mentors will be assigned to each student to guide them in the

learning process, assist with linguistic challenges, and support their overall progress in the selected language.

7. **Activity Framework**: Faculty members, in consultation with language experts, will design a set of language-related activities (e.g., vocabulary building, basic conversations, and cultural immersion tasks) that align with the objectives of each course.
8. **Personal Growth**: Emphasis is placed on selecting a language that aligns with the student's personal interests, academic goals, or global career opportunities, fostering long-term motivation and growth.
9. **Balance and Engagement**: Students are encouraged to choose a course that they are genuinely curious or passionate about, ensuring consistent engagement and maximum benefit from the learning experience.

Baskets for Language Courses:

1. 174408A: Basic English Language

Unit-I: Basic of Communication **06 Hours**

An introduction to phonetics and phonology.

Unit-II: Vocabulary for Communication **06 Hours**

Basic vocabulary and sentence construction, idioms and phrases, antonyms, synonyms.

Part of speech: Noun, pronoun, verb, adjective, adverb, preposition, conjunction, interjection.

Unit-III: Grammar for Communication **06 Hours**

Articles, tense, change the voice, direct- indirect speech, degree, punctuation.

Grammar usage in sentences, sentence structure error, grammar error.

Unit-IV: English for the Real World **06 Hours**

Everyday communication: Introduction, shopping, meeting friends, travelling, telephonic communication, negotiation, etc.

Unit-V: Language Skills for Functional Communication **06 Hours**

Reading skill, listening skills, speaking skills, writing skills. Email correspondence, dialogue writing. Spell check and writing presentation.

2. 174408B: Basic Sanskrit Language

Unit-I: Characteristics of Sanskrit 06 Hours

Introduction: Some unique characteristics of Sanskrit. Basic introduction of oneself, simple verbs daily vocabulary. Introducing different declensions and tenses - 1.

Unit-II: Sentence Structure and Vocabulary for Communication 06 Hours

Basic vocabulary and sentence construction.

Introducing different declensions and tenses – 2.

Practice with various verbs in different moods and tenses summary of the sentence structure with different questions.

Unit-III: Grammar for Communication 06 Hours

Revision of the main features of part 1 of introduction to basic spoken Sanskrit, different verb forms, daily vocabulary.

Introduction of different declensions in the plural and tenses – 1, daily vocabulary, poetic verses, conversations and stories.

Unit-IV: Daily Conversation 06 Hours

Practice with various verbs in different moods and tenses, summary of the sentence structures using the plural with different questions.

Introduction of a few more words ending with consonants and their declensions, an alternative conjugation of verbs, daily vocabulary, poetic verses, conversations and stories.

Introduction to their different declensions in singular, dual and plural, new verb forms, daily vocabulary, poetic verses, conversations and stories.

Unit-V: Comprehension and Conversations 06 Hours

Introduction to Sandhi, vowel with vowel / vowel with consonant / consonant with consonant / aspirant with vowel or consonant, poetic verse, reading and comprehension, conversations.

Practice with a variety of word endings, various verbs in different moods and tenses, summary of the sentence structures using the plural with different questions.

3. 174408C: Basic German Language

Unit-I: Introduction to the Alphabet Articulation 06 Hours

Introduction, greetings and alphabet articulation.

Introducing oneself and others; Grammar: W questions, personal pronouns, simple sentence, verb conjugation.

Themes: Hobbies, the week, numbers, the alphabet, months, seasons / **Grammar:** Articles, plural, the verbs to have and to be.

Unit-II: Word and Sentence Structure 06 Hours

Theme: In the city / naming places and buildings, means of transport, basic directions / **Grammar**: definite and indefinite articles; negation - kein and nicht; imperative.

Themes: food, drink, family / groceries and meals / **Grammar:** the accusative.

Unit-III: Daily Conversation 06 Hours

Theme: Everyday life, telling time, making appointments / **Grammar:** prepositions am, um, von.bis; modal verbs, possessive articles: leisure activity, celebrations.

Unit-IV: Writing Skills 06 Hours

My apartment, rooms, furniture, colours / Grammar: changing prepositions.

Professions / Grammar: perfect tense.

Clothes / Grammar: perfect tense and dative.

Grammar: separable verbs, the accusative, past tense of to have and to be.

Contacts, writing letters / Grammar: dative.

Unit-V: Basic of communication in German Language 06 Hours

Health and the body / Grammar: imperative and modal verbs.

Holiday and weather.

4. 174408D: Basic French Language

Unit-I: Introduction to Alphabets Articulation **06 Hours**

Introduction, greetings and alphabet articulation.

Unit-II: Grammar of French-I **06 Hours**

Indefinite articles and numbers, family vocabulary, colours and numbers.

Unit-III: Grammar of French-II **06 Hours**

Words of politeness, pronouns and conversation.

Unit-IV: Daily Conversation **06 Hours**

6 points to self-introduction, simple propositions and verbs.

Unit-V: Basic of Communication in French Language **06 Hours**

Pieces of communication.

5. 174408E: Basic Japanese Language

Unit-I: Japanese Scripts **06 Hours**

Japanese Scripts: Hiragana, Katakana, Kanji, Ideograms and Pictograms.

Unit-II: Language and Grammar **06 Hours**

Language and Grammar: Particles, sentence construction, demonstratives, interrogatives, conjunctions, vocabulary, nouns, verbs conjugations, adverbs, other parts of speech, verbs and tense, requests and commands, comparisons, expressions and phrases, idioms, etc.

Unit-III: Daily Conversation **06 Hours**

Introduction, time, daily conversation, usage of interrogatives, asking direction, conversation on phone, giving and receiving, making requests and commands, likes and dislikes, potential, permission, conditionals, direct in direct speech, learning to make speeches, writing mails, polite Japanese.

Unit-IV: Japanese Culture, Festivals and Lifestyle **06 Hours**

Japanese culture, festivals and lifestyle: Japanese lifestyle, learning about culture, customs and festivals, idioms and phrases.

Unit-V: Basic of Communication in Japanese Language **06 Hours**

Audio and pictures: Association and meaning. |

Guidelines for Evaluation:

1. Self-Introduction on different occasions (Formal and informal).
2. Public speaking exercises.
3. Common grammar errors/ Sentence structure errors.
4. Writing articles.
5. Vocabulary level test.

Learning Resources:

Text / Reference Books / Web Links:

Basic English Language Course

1. Raymond Murphy's English Grammar in Use Cambridge University Press. 2019
2. A Practical English Grammar, Thomson and Martinet. New Delhi: Oxford University Press, 1986.
3. Study Skills in English: A Course in Reading Skills for Academic Purposes, Michael J. Wallace, Cambridge University Press, 2004.
4. Cambridge English Pronouncing Dictionary (17thEdn.), Cambridge University Press, 2006

Basic Sanskrit Language Course

1. Kumari, S. (1993) Sanskrita Chitrapadakoshah, Mysuru: Bharatiya Bhasha Sansthanam.
2. Samkrita-vyavahaara-saahasree(Samskrit-English, New Delhi: Sanskrita Bharati.
3. Sampad, & Vijay. (2005). The Wonder that is Sanskrit. Pondicherry: Sri Aurobindo Society.
4. Satvlekar, S. D. (2013). Sanskrit Swayam Shikshak. Delhi: Rajpal & Sons (Rajpal Publishing).
5. Shastri, V K. (2012). Teach Yourself Samskrit, Prathama Diksha. Delhi: Rashtryia Sanskrita Samsthana.
6. Vishwasa (2014). Abhyāsa-pustakam, New Delhi: Samskrita Bharati

Basic German Language Course

1. NETZWERK Deutsch alsFremdspracheA1(Goyal, New Delhi, 2015).
2. Schulz-Griesbach: Deutsch alsFremdsprache. Grundstufe in einem Band (for Grammar).

Web Resources:

1. Facts about Germany: https://www.tatsachen-ueber-deutschland.de/en
2. Online German-English dictionary www.leo.org.

Practice materials:

1. https://www.goethe.de/en/spr/kup/prf/prf/sd1/ueb.html
2. https://www.deutschkurse-passau.de/JM/images/stories/SKRIPTEN/a1_skript_gr.pdf
3. https://www.schubert-verlag.de/aufgaben/arbeitsblaetter_a1_z/a1_arbeitsblaetter_index_z.htm

Basic French Language Course

1. Saisons 1 Méthode de français
2. https://www.frenchcircles.ca/
3. https://blog.rosettastone.com/french-accent-marks/

Basic Japanese Language Course

1. Minna no Nihongo Textbook 1 & II (3 A Network).
2. Japanese for Busy people. (Association for Japanese Language Teaching).
3. Nihongo Dekimasu (Japan Foundation).
4. Shin Nihongo no Kiso (Association for Overseas Technical scholarship).
5. First steps in Japanese (3 A Corporation).
6. Kanji and Kana by Wolfgang Hadamitzky and Mark Spahn.
7. 250 Essential Kanji for everyday use Vol. I & 2 by Kanji Research group University of Tokyo.

Course Code: 109409	Course Name: Robotics Modeling and Analysis Laboratory	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 4 Hours/Week	**2**	**TW** : 50 Marks

Expected Prerequisite Courses:

- Basic Programming, Engineering Mathematics, Kinematics of Machinery.

Course Objectives:

- To develop 3D models of robotic systems using CAD tools.
- To analyze kinematic and dynamic behavior of robotic manipulators.
- To perform structural and vibration analysis using CAE tools.
- To integrate modelling, simulation, and optimization techniques in robotic system design.

Course Outcomes:

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

CO1: Identify basic components and coordinate systems of robotic manipulators.

CO2: Develop simple 3D models and assemblies of robotic components using CAD tools.

CO3: Compute basic forward kinematics and workspace of simple manipulators using MATLAB.

CO4: Perform basic structural and modal analysis of robotic components using ANSYS.

List of Practicals:

1. Introduction to Robotic Components and Coordinate Systems-Study basic parts of a robot (links, joints, end-effector) and define coordinate systems using simple examples.
2. 3D Modelling of a Single Robotic Link (Creo)-Create a simple robotic arm link model and determine mass properties.
3. Assembly of Two-Link Robotic Arm (Creo)-Assemble two links with revolute joint and study basic motion.
4. Basic Forward Kinematics Using MATLAB-Calculate end-effector position of a two-link planar robot using simple trigonometric relations.
5. Workspace Plotting of a Two-Link Robot (MATLAB)-Plot reachable workspace of a simple planar manipulator.
6. Basic Trajectory Planning-Generate position vs time graph for linear motion using MATLAB.
7. Static Structural Analysis of a Robotic Link (ANSYS)-Apply simple load on a robotic link and observe stress and deformation.

8. Basic Modal Analysis-Determine first natural frequency of a robotic link using ANSYS.

Learning Resources:

Text Books:

1. Siciliano, Bruno, Lorenzo Sciavicco, Luigi Villani, and Giuseppe Oriolo. Robotics: Modeling, Planning and Control. London: Springer, 2009
2. Craig, John J. Introduction to Robotics: Mechanics and Control. 3rd ed. Upper Saddle River, N.J.: Pearson/Prentice Hall, 2005
3. Groover, Mikell P. Industrial Robotics: Technology, Programming, and Applications. New York: McGraw-Hill, 1986.

Reference Books:

1. Corke, Peter. Robotics, Vision and Control: Fundamental Algorithms in MATLAB®. 2nd ed. Cham, Switzerland: Springer, 2017.
2. Stolarski, Tadeusz, Y. Nakasone, and S. Yoshimoto. Engineering Analysis with ANSYS Software. 2nd ed. Oxford: Butterworth-Heinemann, 2018.
3. Moore, Holly. MATLAB for Engineers. 6th ed. Hoboken, NJ: Pearson, 2021.

Weblink for MOOC / NPTEL Links:

1. **MathWorks**-MATLAB Onramp https://matlabacademy.mathworks.com
2. **ANSYS**-ANSYS Learning Hub https://www.ansys.com/academic
3. https://onlinecourses.nptel.ac.in/noc25_me85/preview#:~:text=ABOUT%20THE%20COURSE:,etc)%2C%20process%20industries%20using%20robotics
4. https://nptel.ac.in/courses/112108298
5. https://onlinecourses.nptel.ac.in/noc20_de11/preview#:~:text=Course%20layout,12:Introduction%20to%20Reinforcement%20Learning
6. https://onlinecourses.nptel.ac.in/noc26_me36/preview#:~:text=ABOUT%20THE%20COURSE:,Summary
7. https://onlinecourses.nptel.ac.in/noc20_me53/preview#:~:text=Course%20layout,Acceleration%20Analysis%2C%20Force%20Analysis%2DI

Course Code: 109410	Course Name: Industrial Electronics and Electrical Machines Laboratory	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 2 Hours/Week	**1**	**TW** : 25 Marks **PR + OR** : 25 Marks

Expected Prerequisite Courses:

- Engineering Physics, Basic Electrical Engineering.

Course Objectives:

- To reinforce understanding of fundamental concepts in industrial electronics and electrical technology through practical experimentation.
- To impart hands-on experience with microcontroller (Arduino) programming and sensor integration for industrial automation.
- To enable students to experimentally analyze and evaluate the performance characteristics of DC and AC electrical machines.
- To provide practical exposure to the control methods of special-purpose motors and actuators used in robotics and automation.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Develop and test Arduino-based embedded systems for sensor interfacing and basic automation tasks.

CO2: Experimentally verify and analyze the performance and control strategies of DC motors for industrial automation scenarios.

CO3: Evaluate AC motor operations and effectively implement suitable starting and load control methods.

CO4: Demonstrate hands-on skills in controlling stepper, servo, and BLDC motors for robotics and automation applications**.**

CO5: Integrate sensors, actuators, and Arduino controllers to successfully design, build, and present a simple automated system through a mini-project.

Learning Resources:

Text Books:

1. Electrical Machines – I.J. Nagrath & D.P. Kothari
2. Electric Machinery Fundamentals – Stephen J. Chapman
3. Principles of Electrical Machines – V.K. Mehta & Rohit Mehta
4. Industrial Electronics – G.K. Mithal
5. Power Electronics – P.S. Bimbhra
6. Industrial Electronics and Control – S.K. Bhattacharya
7. Power Electronics: Circuits, Devices & Applications – M.H. Rashid.

Reference Books:

1. A Course in Electrical & Electronic Measurements & Instrumentation – A.K. Sawhney
2. Modern Power Electronics & AC Drives – B.K. Bose
3. Electric Drives – G.K. Dubey
4. Industrial Control Electronics – Terry Bartelt.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/108105155
2. https://nptel.ac.in/courses/108105062

List of Practicals:

1. Interfacing of LED to blink after every 1 sec with Arduino
2. Digital Sensor Interfacing with Arduino (e.g., Proximity switches).
3. Analog Sensor Interfacing with Arduino (e.g., Temperature /Humidity sensors).
4. Experimental verification of performance characteristics of a Brushed DC Shunt Motor.
5. Relay Interfacing with Arduino for high-voltage industrial load switching.
6. Implementation of PWM-based H-Bridge speed and direction control of a DC Motor using Arduino.
7. Load test on 3 phase Induction Motor to get performance characteristics.
8. Speed control of 3 phase induction motor by variable frequency drive (VFD)
9. Precision angular position control of an RC Servo Motor using Arduino.
10. Driver interfacing and stepping mode execution (Full/Half step) of a Stepper Motor.
11. Microcontroller based speed control of a Brushless DC (BLDC) motor.
12. Mini-Project Execution: Design and assembly of a simple automated system (e.g., automated sorting conveyor, solar tracker, or simple robotic arm joint) including a group presentation.

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