RAMAIAH
Institute of Technology

CURRICULUM

Academic Year 2026 – 2027

VII & VIII SEMESTER
B.E: MECHANICAL ENGINEERING
Batch 2023

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Approved by AICTE, New Delhi and Govt. of Karnataka Accredited by NBA&NAAC with A^+ Grade

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 18 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by

National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by**

NAAC in March 2021 for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 70% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. The Entrepreneurship Development Cell (EDC) and "Ramaiah Evolute" have been set up on campus to incubate startups. MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to

International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 75th rank among 1584 top Engineering Institutions & 31st Rank among 131 Architecture Institutions, for the year 2025.

About the Department:

The Department of Mechanical Engineering started in the year 1962 with an intake of 40 students. The department has grown strong over the last 63 years and today has an intake of 120 students and 32 teaching staff. All the faculty members are well qualified and possess post graduate degree with 24 doctorates. The department offers four-year degree course and offers one Master Degree in Robotics and Artificial Intelligence, with an intake of 18. The Department also offers research program which includes MSc Engineering by research and PhD degree from Visvesvaraya Technological University and at present 26 researchers are pursuing PhD. The faculty members have taken up number of research projects funded by external agencies like DRDO, DST, AICTE, IIT Indore, SERB, VGST and Visvesvaraya Technological University and received funding more than Rs 1.4 Crores. The department has exemplified its dedication to scholarly advancement by organizing a national-level project exhibition and convening esteemed international conferences, including the International Conference on Recent Advances in Engineering Sciences (ICRAES) and the International Conference on Mechanics of Advanced Materials and Structures (ICMAMS). These initiatives have served as pivotal forums for intellectual discourse, fostering innovation and facilitating the dissemination of cutting-edge research within the academic community. Faculty members from the department have published books on different domains of Mechanical Engineering and are recommended by Visvesvaraya Technological University Board of Studies as reference textbooks.

The department consistently fosters and facilitates student participation in technical competitions and projects to advance their academic expertise and professional development. Team EDITHA participated in the Student Unmanned Aerial System (SUAS) competition held in Maryland, California, USA, from June 24th to 26th, 2025. The team distinguished itself by securing an overall fourth place, accompanied by a prize award of USD 1,000, as well as achieving third place in the technical design report category.

The department has achieved significant recognition through its team, CO2 - Velocita Racing, at the Formula Bharat 2025 competition held at Kari Motor Speedway, Coimbatore, from January 22 to 27, 2025. The team secured an overall 2nd place in the combustion category, demonstrating excellence across multiple events including Engineering Design (2nd place), Acceleration (winner), Autocross (winner), and Skidpad (winner). Their outstanding performance earned them a total overall score of 538.41 points with no penalties, reflecting their technical expertise and innovative engineering capabilities. This achievement underscores the department’s commitment to fostering high-level competitive skills, practical engineering application, and collaborative innovation among its students.

1. VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

2. MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

3. QUALITY POLICY

We at M S Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

4. VISION OF THE DEPARTMENT

To be a centre of international repute in Mechanical Engineering and to create qualified human resources needed to meet the demanding challenges in different areas and emerging fields of Mechanical Engineering and allied sciences.

5. MISSION OF THE DEPARTMENT

To impart quality technical education to meet the growing needs of the profession through conducive and creative learning environment, to produce qualified and skilled human resources, create R&D environment, to be a centre of excellence and to offer post graduate programs in the emerging fields of Mechanical Engineering.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS):

- To produce engineers with sound basic theoretical knowledge along with required practical skills in various specialized fields of Mechanical Engineering.
- To inculcate team work capabilities and communication skills among students through cocurricular activities.
- To motivate students for higher studies in specialized areas of Mechanical Engineering and explore possible profession in R & D, academic and self-employment opportunities.
- To bring in awareness on environmental issues and commitments towards Professional ethics, social responsibilities and need for lifelong learning

PROGRAM OUTCOMES (POs):

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSOs OF THE PROGRAM OFFERED:

Mechanical Engineering Graduates will be able to:

PSO1: Ability to apply their knowledge in engineering mechanics, materials science, design, thermal engineering, production, management, CAD/CAM, robotics - on an applied basis.

PSO2: Ability to apply the learned principles to the analysis, design, development and implementation to advanced mechanical systems and processes, be prepared to work professionally in Mechanical Engineering domain.

Semester wise Credit Breakdown for BE Degree Curriculum
BATCH 2023-2027

Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	–	–	03	03	–	–	–	–	06
Applied Science Course [ASC(I)]	4	4	–	–	–	–	–	–	08
Applied Science Course (ASC)	4	4	–	–	–	–	–	–	08
Emerging Technology Course (ETC)	3	–	–	–	–	–	–	–	03
Programming Language Course (PLC)	–	3	–	–	–	–	–	–	03
Engineering Sciences (ESC)	5	5	–	–	–	–	–	–	10
Humanities, Social Sciences and Management (HSMC)	2	2	–	–	03	03	–	–	10
Ability Enhancement Course (AEC)	2	2	01	01	01	01	02	–	10
Universal Human Values (UHV)	–	–	02	–	–	–	–	–	02
Professional Core Courses (PCC)	–	–	11	12	12	06	04	–	45
Integrated Professional Core Course (IPCC)	–	–	04	04	03	–	04	–	15
Professional Elective Courses (PEC)	–	–	–	–	03	06	03	–	12
Institutional Open Elective Courses (IOE)	–	–	–	–	–	03	03	–	06
Internship (INT)	–	–	–	–	–	–	–	05	05
Mini Project / Project Work (PW)	–	–	–	–	–	04	–	13	17
Non-Credit Mandatory Courses (NCMC)	–	–	–	–	–	–	–	–	–
Total Credits	**20**	**20**	**21**	**20**	**22**	**23**	**16**	**18**	**160**

B.E. in Mechanical Engineering
SCHEME OF TEACHING
Batch 2023

VII SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours/week
					L	T	P	Total	
1	ME71	CAD/CAM	Mechanical	IPCC	3	0	1	4	5
2	ME72	Vibration and control engineering	Mechanical	PCC	2	1	0	3	3
3	MEE73x	Program Elective Course – 4	Mechanical	PEC	3	0	0	3	3
4	MEOE0x*	Institutional Open Elective - 2	Mechanical	IOE	3	0	0	3	3
5	MEL74	Robotics and Simulation Laboratory	Mechanical	PCC	0	0	1	1	2
6	AEL75	Data Analytics and Modelling	Mechanical	AEC	0	1	1	2	4
				Total	**11**	**2**	**3**	**16**	**20**

LIST OF COURSES OFFERED UNDER PROGRAM ELECTIVE COURSE - 4 CREDITS: 3:0:0

Sl. No.	Subject Code	Subject
1	MEE731	Product Design and Manufacturing
2	MEE732	Wind Energy
3	MEE733	Automotive Engineering
4	MEE734	Foundry Technology
5	MEE735	Operation Management
6	MEE736	Artificial Intelligence

LIST OF COURSES OFFERED UNDER OPEN ELECTIVE COURSE –2 CREDITS: 3:0:0

Sl. No.	Subject Code	Subject
1	MEOE09	Fundamentals of Electric Vehicle Technology
2	MEOE10	Science, Education & Technology for Rural India

Nomenclature: IPCC: Integrated Professional Core Course**, PCC:** Professional Core Course**, PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **AEC:** Ability Enhancement Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: ME73x, where x=1,2,3,4,5,6…
MEOE0x*, where x=6,7,8,9, 10, continued from previous

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses are added to supplement the latest trend and advanced technology in the selected engineering stream. Each group provides an option to select one course out of five courses. The minimum student strength for offering professional electives is 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Proctor.

Selection of an open elective shall not be allowed if,

The candidate has studied the same course during the previous semesters of the program. The syllabus content of open electives is similar to that of the Departmental core courses or professional electives. A similar course, under any category, is prescribed in the higher semesters of the program.

The minimum students' strength for offering open electives is 10.

AICTE Activity Points to be earned by students admitted to the BE program:

Every regular student who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fail to earn the prescribed activity points; VIII semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII Semester grade card.

B.E. in Mechanical Engineering
SCHEME OF TEACHING
Batch 2022

VIII SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	MEP81	Project Work	Mechanical	PCC	0	0	13	13	-
2	INT82	Research/Industrial Internship	Mechanical	INT	0	0	5	5	-
				Total			18	**18**	

Nomenclature: PW: Project Work, I**NT: Internship**

L – Lecture, T – Tutorial, P – Practical/Drawing

VII SEMESTER

CAD/CAM	
Subject Code: ME71	**Credits: 3:0:1**
Pre-requisites: Nil	**Contact Hours: 42L + 28P**
Course Coordinator: Dr. Sunith Babu L	

Course Content Unit I

Introduction: Definitions and Scope of CAD/CAM, systems, applications, Product Cycle integrated with CAD/CAM

Hardware for CAD/CAM: Basic configuration of a typical Modern hardware for CAD/CAM – Vector stroke and raster scan output devices for CAD. RFID and barcode readers for CAD/CAM applications.

Software for CAD/CAM: A typical CAD/CAM database uses cloud computing techniques for CAD/CAM, cloud-based CAD tools, SaaS, PaaS,

- Pedagogy/Course delivery tools: -Chalk and talk, PowerPoint presentation, animated videos
- Lab component/Practical topics: -5 Exercises related to Cloud-Based Part and Assembly Modelling
- Links: -https://youtu.be/GSewsQRmEAQ

Unit II

Computer Graphics: Raster Scan Graphics, Pixels, Coordinate System, Colour and Shapes, Database Structure for Graphic Modeling, functions of graphics package, Transformation of geometry, 2D transformations – Simple problems, AR/VR and its applications in CAD, Parametric and Generative Design GPU based geometric modeling, Digital Twin and Geometric Models **3D and Geometric Modelling:** Introduction, Types of geometric models, Sketching and Sketch Planes, Parametric Modelling, Geometric Constraints, Requirements for geometric modelling, Geometric Models, Geometric-Based Modelling, Constrain Based Modelling, Curve Representation, Surface Representation methods.

- Pedagogy/ Course delivery tools: -Chalk and talk, PowerPoint presentation, animated videos, Demonstration using IC engine models
- Lab component/Practical topics: - Geometric and Parametric Modelling • Links: - https://youtu.be/6LjVtIcSbK8

Unit III

Introduction to CNC technology: Basic components of NC system, modes, elements, machine tools, Structure of CNC Machine Tools, Spindle Design, Drives, Actuation System, Feedback Devices.

DNC, CNC Systems: Types, advantages of adaptive control systems, types of CNC turning centres and machining centres,

- Pedagogy/ Course delivery tools: - Chalk and talk, PowerPoint presentation, animated videos
- Links: -https://youtu.be/B7MM5M7DzpM

Unit IV

CNC Programming – Programming of CNC lathe and a machining center for real-time components for 2 and 3-axis (lathe and milling), machining centers for a typical CNC controller.

- Pedagogy/ Course delivery tools: -Chalk and talk, PowerPoint, presentation, animated videos

1. Lab component/Practical topics: - 5 Exercises related to CAM Programming both Turning and Milling

- Links-https://youtu.be/_5r2XR1h1aQ

Unit V

Flexible manufacturing system: FMS Equipment, FMS layouts, Analysis methods of FMS, Benefits of FMS. Computer-aided quality control& Manufacturing: Automated inspection offline and online, Material resource planning, benefits of MRP, Enterprise resource planning, capacity requirements planning**.**

Robotics: Definition, History, Classification, Terminologies, Configuration, System Integration, End-Effector, Grippers, Programming on Pick and Place and Applications.

- Pedagogy/ Course delivery tools: Chalk and talk, PowerPoint presentation, animated videos

2. Lab component/Practical topics:- 2 Exercises related to Pneumatic and Hydraulic Control Systems

- Links: -https://youtu.be/a6_fgnuuYfE

Text Books:

1. CAD/CAM principles and applications by P.N. Rao, Tata McGraw-Hill, 2002.
2. CAD/CAM by Groover, Tata McGraw-Hill, 1st July 2017, ISBN 978-0070681934.

Reference Books:

1. Mastering CAD/CAM, Ibrahim Zeid, Tata McGraw-Hill Publishing Co.
2. Introduction to CAD/CAM Rao P.N., Tata McGraw-Hill Publishing Co.
3. Automation, production systems and computer-integrated manufacturing, Groover M.P., Prentice Hall of India
4. CAD/CAM/CIM, Radhakrishnan P, ISBN-8122422365, New Age Int Publishers.
5. James G. Keramas, Robot Technology Fundamentals, Delmar Publishers.

Web links and video lectures (e-Resources):

1. http://www.nptelvideos.in/2012/12/robotics.html
2. https://nptel.ac.in/courses/112102101
3. https://nptel.ac.in/courses/112102103

Course Outcomes (COs):

At the end of the course, the student will:

1. Understand the different CAD Hardware and software modules. [PO1, PO3, PO5, PO12, PSO1, PSO2]
2. Apply the CAD database and transformation functions for computing different types of geometric entities. [PO1, PO2, PO3, PO5, PO11, PO12, PSO1, PSO2]
3. Demonstrate NC technology and adaptive control machining in a computer-aided manufacturing environment [PO1, PO2, PO3, PO5, PO11, PO12, PSO1, PSO2]
4. Develop NC programs based on sketches using G & M Codes. [PO1, PO2, PO3, PO11, PO12, PSO1, PSO2]
5. Analyze different technologies supporting CAD/CAM [PO1, PO2, PO3, PO5, PO11, PO12, PSO1, PSO2]

Course Assessment and Evaluation

Continuous Internal Evaluation (CIE)- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination- 100 Marks		
Semester End Examination (SEE)	100	CO-1, CO-2, CO-3, CO-4 & CO-5

VIBRATION AND CONTROL ENGINEERING	
Subject Code: ME72	**Credits: 2:1:0**
Prerequisites: Nil	**Contact Hours: 28L + 14T**
Course Coordinator: Dr. Vishwanath Koti and Dr. Girish V Kulkarni	

Course Content Unit I

Introduction: Types of vibrations, S.H.M, Beats.

Undamped free vibrations: Single degree of freedom systems. Undamped free vibration natural frequency of free vibration. Effect of mass of spring, Compound Pendulum. **Simple numerical**

Damped free vibrations: Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement. **Simple numerical**

- Pedagogy/Course delivery tools: - Chalk and talk, Power Point presentation, animated videos
- Links: -https://www.digimat.in/nptel/courses/video/112107212/L01.html
- Links: -https://www.digimat.in/nptel/courses/video/112107212/L06.html https://www.digimat.in/nptel/courses/video/112107212/L08.html

Unit II

Forced Vibration: Reciprocating and rotating unbalance, vibration isolation-transmissibility ratio, due to harmonic excitation and support motion. **Simple numerical**

Systems with two degrees of freedom: Introduction, principal modes and Normal modes of vibration, coordinate coupling, generalized and principal co-ordinates, free vibration in terms of initial conditions. Applications: Vehicle suspension. Dynamic vibration absorber

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation, animated videos
- Links: -https://www.digimat.in/nptel/courses/video/112107212/L11.html https://www.digimat.in/nptel/courses/video/112107212/L18.html
- Links: -https://www.digimat.in/nptel/courses/video/112107212/L27.html

Unit III

Numerical methods for Multi-degree Freedom systems: Introduction, Influence coefficients, Maxwell reciprocal theorem, Stodola method

Introduction: Concept of automatic controls, open and closed loop systems, requirement of an ideal control system and Transfer function of physical systems

Block Diagrams and Signal Flow Graphs: Block representation of system elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation, animated videos
- Links: -https://www.digimat.in/nptel/courses/video/112107212/L38.html https://archive.nptel.ac.in/courses/108/106/108106098/

Unit IV

Stability Analysis: R H Criteria. Simple numerical **Root locus method:** Significance of Root locus, angle and magnitude conditions, breakaway points, angles of departure and arrival, construction of Root locus using general rules and steps, Numerical on root locus plots

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation, animated videos
- Links: -https://archive.nptel.ac.in/courses/108/106/108106098/
- Links:-https://archive.nptel.ac.in/courses/108/106/108106098/ https://archive.nptel.ac.in/courses/108/106/108106098/

Unit V

Introduction to frequency response analysis: Nyquist and Bode Plots, Simple numerical **System Compensation & Control actions:** Series and feedback compensation, Types of Controllers-Proportional, Integral, Differential, Proportional & Integral, Proportional Differential and Proportional Integral Differential controllers

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint presentation, animated videos
- Links:-https://archive.nptel.ac.in/courses/108/106/108106098/ https://archive.nptel.ac.in/courses/108/106/108106098/
- Links:-https://archive.nptel.ac.in/courses/108/106/108106098/ https://archive.nptel.ac.in/courses/108/106/108106098/

Text Books:

1. Theory of Vibration with Applications: W.T. Thomson and Marie Dillon Dahleh, Pearson Education ,5th edition, 2007.
2. Mechanical Vibrations: V.P. Singh, Dhanpat Rai & Company Pvt. Ltd., 3rd edition, 2006.
3. Modern Control Engineering: Katsuhiko Ogata, Pearson Education, 2008.
4. Control Systems Principles and Design: M. Gopal, TMH, 2010
5. Control Engineering: U.A. Bakshi & V.U. Bakshi, Technical publications, Pune,2009 6. Control Systems Engineering: Nise, Wiley, Fourth edition

Reference Books:

1. Mechanical Vibrations: S.S. Rao, Pearson Education Inc., 4th Edition, 2003.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's Outline Series, Tata McGraw-Hill, Special Indian edition, 2007.
3. Theory & Practice of Mechanical Vibrations: J.S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.
4. Elements of Vibrations Analysis: Leonanrd Meirovitch, Tata McGraw Hill, Special Indian edition, 2007
5. Feedback Control Systems: Schaum's series 2010.
6. Control systems: I.J. Nagarath & M. Gopal, New Age International Publishers 2012.
7. Automatic Control Systems – B.C. Kuo, F. Golnaraghi, John Wiley & Sons, 2008.
8. Modern Control Engineering: Dorf, Bishop, Pearson, Eleventh edition

Course Outcomes (COs):

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

1. Develop an understanding of the concept of Vibrations, undamped and damped free vibrations. [PO1, PO2, PO3, PO4, PO12, PSO1 & PSO2]
2. Develop competence and skills to analyse the forced vibration and the system with two degrees of freedom. [PO1, PO2, PO3, PO4, PO12, PSO1 & PSO2]
3. Develop the ability and skill for solving multi-degree of freedom systems and control engineering as well as to find transfer functions of block diagram and signal flow graph. [PO1, PO2, PO3, PO4, PO12, PSO1 & PSO2]
4. Demonstrate the closed loop system stability using RH criteria and root locus techniques. [PO1, PO2, PO3, PO4, PO12, PSO1 & PSO2]
5. Study and analyse the frequency response of the closed system using Nyquist and Bode plots and to develop competence in controllers and compensators. [PO1, PO2, PO3, PO4, PO12, PSO1 & PSO2]

Course Assessment and Evaluation

Continuous Internal Evaluation (CIE)- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination- 100 Marks		
Semester End Examination (SEE)	100	CO-1, CO-2, CO-3, CO-4 & CO-5

PRODUCT DESIGN AND MANUFACTURING	
Subject Code: MEE731	**Credits: 3:0:0**
Prerequisites: Nil	**Contact Hours: 42 L**
Course Coordinator: Dr. D. K. Vishwas	

Course Content Unit I

Asimow's model: Definition of product design, Design by Evolution, Design by Innovation, Essential Factors of Product design, Production-Consumption Cycle, Flow and Value Addition in the Production-Consumption Cycle,

The Morphology of Design (The seven phases), Primary Design Phases and Flowcharting, Role of Allowance, Process Capability and Tolerance in Detailed Design & Assembly.

Product Design Practice and Industry-Introduction: Product Strategies, Time to Market, Analysis of the Product, The S's Standardization, Renard Series, Simplification, Role of Aesthetics in Product Design, Functional Design Practice.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation, animated videos
- Links: Introduction to Product Design, Morphology- https://youtu.be/4j5tj3wF3ig https://youtu.be/67-Ia48Q-5o

Unit II

Principal Stress Trajectories (Force-Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience Designing for Uniform Strength, Tension vis-a-vis Compression. Review of Production Process: Introduction, Primary Processes, Machining Process, Non-traditional Machining Processes.

Design for Production: Metal Parts: Producibility requirements in the Design of machine Components, Forging Design, pressed components Design, Casting Design, and Design for Machining Ease, The Role of Process Engineer, Ease of Location Casting and Special Casting, Designing with Plastic, rubber, ceramics and wood: Approach to design with plastics, plastic bush bearings, gears in plastics, rubber parts, design recommendations for rubber parts, ceramic and glass parts.

- Pedagogy/ Course delivery tools: -Chalk and talk, Power point presentation, animated videos,
- Links: Manufacturing Process Selection
- Links: Materials Selection-https://youtu.be/JHWgnuwrD7c https://youtu.be/emWDFW1Cj-I

Unit III

Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Linear Programming (Simplex Method), Geometric Programming, Johnson's Method of Optimum Design.

Economic Factor Influencing Design: Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break–even Analysis, Economics of a New Product Design.

- Pedagogy/ Course delivery tools: -Chalk and talk, Power point presentation, animated videos

Links: Optimization: An Introduction-https://youtu.be/QTi0Mv7DGDs

Unit IV

Introduction, Human being as Applicator of Forces, Anthropometry; Man as occupant of Space, the Design of Controls, the Design of Displays, Man/Machine Information Exchange.

- Pedagogy/Course delivery tools: -Chalk and talk, Power point presentation, animated videos

Links: Ergonomics in Product Design-https://youtu.be/1GRvasLjPag

Unit V

Introduction, Historical Perspective, what is Value? Nature and Measurement of Value, Normal Degree of Value, Importance of Value, The Value Analysis Job Plan, Creativity, steps to Problems solving and Value Analysis, Value Analysis Test, Value Engineering Idea Generation Check-list, Reduction through value engineering case study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering

Modern Approaches to Product Design: Concurrent Design and Quality Function Deployment (QFD)

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation, animated videos
- Links: Value Engineering -https://youtu.be/pukn_fmJwuw

Reference Books:

1. **New Product Development**- Tim Jones, Butterworth Heinmann, Oxford, mc1997
2. **New Product Development**- Design & Analysis by Roland Engene Kinetovicz, John Wiley and Sons Inc., N.Y.1990

Text Books:

1. **Product Design and Manufacturing** – A.K Chitale and R.C. Gupta, PHI 4th Edition, 2007
2. **Product Design & Development** - Karl T.Ulrich& Steven D, Epinger, Tata Mc. Graw Hill, 3rd Edition, 2003

Web links and video lectures (e-Resources):

1. https://youtu.be/4j5tj3wF3ig
2. https://youtu.be/67-Ia48Q-5o
3. https://youtu.be/emWDFW1Cj-I
4. https://youtu.be/QTi0Mv7DGDs
5. https://youtu.be/1GRvasLjPag
6. https://youtu.be/pukn_fmJwuw

Course Outcomes (COs):

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

1. The student will analyse the basic approaches in product design by following the standard design phases practiced in an industry. [PO1,PO2,PO3,PO4,PO5,PO12,PSO1,PSO2]
2. The student will understand the importance of consideration of various material properties and abilities of manufacturing aspects in product design. [PO1, PO2, PO4, PO5, PO12, PSO1, PSO2]

3. The students will be able to evaluate the economics and optimizations of the design for the best profit level by not compromising its utility. [PO1, PO2, PO3, PO5, PO12, PSO1, PSO2]
4. The students will apply the use of computers in design and other related areas of a manufacturing industry in consideration with safety, reliability and environmental aspects. [PO1, PO2, PO3, PO4, PO12, PSO1, PSO2]
5. The students will demonstrate the effective problem-solving techniques and modern design approaches. [PO1, PO2, PO3, PO4, PO5, PSO1, PSO2]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE)- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
The average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination (SEE)- 100 Marks		
Semester End Examination	100	CO-1, CO-2, CO-3, CO-4 & CO-5

WIND ENERGY	
Subject Code: MEE732	**Credits: 3:0:0**
Prerequisites: Nil	**Contact Hours: 42 L**
Course Coordinator: Dr. Puttabore Gowda	

Course Content Unit I

Introduction: Origin of Winds, Nature of winds, Modern wind turbines; Wind resource; Technology achievements; Wind energy penetration level.

Wind Power in India: Introduction, Commercial Wind Power Development, wind turbine manufacturing Industry, Current wind power Scenario and Challenges and opportunities.

- Pedagogy/Course delivery tools: - Chalk and talk/ Power point presentation/ animated videos.
- Links: Origin of Winds and Nature of wind https://www.youtube.com/watch?v=64KZxFjZIWI
- Links: wind turbine manufacturing Industryhttps://www.youtube.com/watch?v=cv9457JNF2w

Unit II

Types of Wind Turbine Plants: Introduction, Types axis, Upwind and Downwind WPPSs, Blade count, Power rating of WPPs Classification of wind turbines; turbine components

Aerodynamics: Introduction; Aerofoil; Actuator disc; Axial moment theory; Momentum theory of rotating wake; Blade element theory; Strip theory; Tip losses; Tip loss correction; Wind machine parameters; Cp - λ characteristics, SERI blade sections; Wind machine mechanics; Numerical problems.

- Pedagogy/ Course delivery tools: - Chalk and talk/ Power point presentation/ animated videos.
- Links: Types of Wind Turbine-https://www.youtube.com/watch?v=60onEs-QH68&t=397s
  Links: Aerofoil-https://www.youtube.com/watch?v=tyJjcX9VZsE

Unit III

Wind turbine design: Rotor torque power, optimum design for variable operation, influence of Reynolds number, cambered airfoils, load calculation, Cost modeling, power control, braking systems, turbine blade design, rotor hub.

- Pedagogy/ Course delivery tools: -Chalk and talk/ Power point presentation/ animated videos.
- Links: braking systems-https://www.youtube.com/watch?v=X8lKyut18Sc
- Links: turbine blade design-https://www.youtube.com/watch?v=p5k2LhKBSgQ&t=160s

Unit IV

Siting and wind farm design: Wind flow modeling, power cure for wind turbine generator; capacity factor; planning of wind farms, siting, wake models.

Wind energy economics: Annual Energy output; Simple payback period; Capital recovery factor, Depreciation; Life cycle costing; Project appraisal.

- Pedagogy/ Course delivery tools: -Chalk and talk/ Power point presentation/ animated videos.
- Links: Site selction- https://www.youtube.com/watch?v=NNBFpkNrhbY
- Links: Annual Energy output-https://www.youtube.com/watch?v=fFZORYi1f34

Unit V

Electrical and control systems: Classification of electrical machines; synchronous and induction generators; Variable speed generators; Control systems; Power collection systems; Earthing of wind farms; Embedded (Dispersed)wind generation.

Environmental Impact: Impact of wind power on the environment, Benefit of wind power for the environment, Land demand, Local impact: Physical impact, Sound propagation, shadow and reflexes.

- Pedagogy/ Course delivery tools: Chalk and talk/PowerPoint point presentation/ animated videos.
- Links: Induction generators-https://www.youtube.com/watch?v=cNKklBwnhY4
- Links: Impact of wind power on environment https://www.youtube.com/watch?v=TBWpJAgZZEE

Text Books:

1. Wind Energy - Theory and practical by Siraj Ahemad, PHI learning private Limited, Eastern Economic Edition, New Delhi, 2010.

Reference Books:

1. Freis, L.L, Wind energy conversion systems, Prentice Hall.
2. Spera, D.A., Wind Turbine Technology; Fundamental concepts of wind turbine Engineering, ASME press.

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=GExTwRNkQBg
2. https://www.youtube.com/watch?v=gMxPkVQYXz8
3. https://www.youtube.com/watch?v=NmL3qsfR8lI
4. https://www.youtube.com/watch?v=ntk-zX7zz6o
5. https://www.youtube.com/watch?v=zYeYN80SJCY

Course Outcomes (COs):

1. Acquaint the modern wind turbines, components and various types of wind turbines (PO1, 2, 10, 11, 12, PSO1).
2. Understand the methods and importance of wind resource assessment (PO1, 2, 12, PSO1).
3. Apply the aerodynamic and performance parameters in wind turbines (PO1, 2, 11, 12, PSO1, 2).
4. Analyze the wind turbine design and various aspects of sitting and wind farm design (PO1, 2, 10, 11, 12, PSO1, 2).
5. Evaluate the issues related to economics and environmental impacts of wind energy generation (PO1, 2, 3, 6, 12, PSO1, 2).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) - 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Quiz/Presentation	10	CO-1, CO-2, CO-3
Assignment	10	CO-4 & CO-5
Semester End Examination (SEE) - 100 Marks		
Semester End Examination	100	CO-1, CO-2, CO-3, CO-4 & CO-5

AUTOMOTIVE TECHNOLOGY	
Subject Code: MEE733	**Credits: 3:0:0**
Pre-requisites: Nil	**Contact Hours: 42 L**
Course Coordinator: Mr. Naveen Kumar B K	

Course Content Unit I

I.C. Engine Components, Cooling & Lubrication systems: SI & CI engines, cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms, valve and port timing diagrams, Compression ratio, choice of materials for different engine components, engine positioning, cooling requirements, methods of cooling, different lubrication arrangements.

Flex Fuels Engine: Alternative fuels, Introduction to LPG and Compressed Natural Gas (CNG) operation of SI engines; operation of SI engines with alternate fuels like ethanol and ethanol blends, production of ethanol, introduction to the working principle of hydrogen and fuel cells, and automotive vehicles.

- Pedagogy/ Course delivery tools: Chalk and talk, PowerPoint presentation, animated videos
  . Lab component/Practical topics: Toyota chassis engine lab.
- Links: I C engine: https://www.youtube.com/watch?v=H_RgFXjg-5s
- Links: Ethanol production: https://www.youtube.com/watch?v=eZv6oOWsfBM

Unit II

Fuel supply systems for SI and CI engines: Properties of air-fuel mixtures - Mixture requirements for steady state and transient operation, Mixture formation studies of volatile fuels, design of elementary carburetor, simple carburetor systems, mono point, multi-point and direct fuel injection systems - Principles and Features, Bosch fuel injection systems. Fuel feed systems, Mechanical and electrical fuel pumps. Normal and abnormal combustion.

Superchargers and Turbochargers: Introduction, Supercharger & Turbocharger construction and operation, Intercooler, Turbocharger lag.

Ignition systems: Battery Ignition systems, Magneto Ignition system, Electronics Ignition system, Ignition advance systems and its importance.

- Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated videos
  Lab component/Practical topics: Applied thermodynamics lab.
- Links: Carburettorhttps://www.youtube.com/watch?v=eDF93dVvH14
- Links: Turbocharger-https://www.youtube.com/watch?v=sY0AHMnsAOo

Unit III

Power Trains: - Clutch: Principle of friction clutches and constructional details, Single plate, multiplate and centrifugal clutches.

Gear box: Types of transmission, synchromesh gear box. Freewheeling mechanism, planetary gears systems, over drives, fluid coupling and torque converters, Epi-cyclic gear box, principles of automatic transmission, Dual Clutch Transmission (DCT), Continuously Variable Transmission (CVT), Automatic Manual Transmission (AMT). (No numerical).

Drive to wheels. Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, condition for exact steering, steering gears, power steering- hydraulic and electric power assisted, over steer, under steer and neutral steer (No numerical).

- Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated videos Lab component/Practical topics: Toyota chassis engine lab. Applied thermodynamics lab.
- Links: Power transfer Engine to wheelhttps://www.youtube.com/watch?v=Dh7IrZXM2mg
- Links: Types of Transmission System (Manual, AT, AMT, iMT, CVT, DCT) https://www.youtube.com/watch?v=ftJKqKuppF4

Unit IV

Automotive Chassis: Types of chassis layout with reference to power plant locations and drive, Vehicle frames. Various types of frames. Constructional details, Materials. Testing of vehicle frames. Unitized frame body construction: Loads acting on vehicle frame.

Suspension and springs: Requirements, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system. Telescopic Shock absorber, MacPherson strut suspension system.

Brakes: Types of brakes, mechanical, air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system. (No numerical)

- Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics: Machine design lab and Toyota chassis engine lab
- Links: Automobile Chasis & it's typeshttps://www.youtube.com/watch?v=I0kToZLtaOQ
- Links: Anti-Lock Brake System (ABS) Workshttps://www.youtube.com/watch?v=vVxVGVYTKtk

Unit V

Automotive emission control systems: Automotive emission controls, controlling crankcase emissions, controlling evaporative emissions, Cleaning the exhaust gas, Controlling the air-fuel mixture, Controlling the combustion process, Exhaust gas recirculation, Treating the exhaust gas, Catalytic converter, Emission standards- Euro I, II, III and IV norms, Bharat Stage II, III, IV and VI norms.

Electrical Propulsion System: Automotive Vehicle application batteries and motors (Basic).

MEMS in Automotive: MEMS sensors for engine management (ECU), Tire pressure sensors, electronic stability control of the vehicles, Rollover and Skidding detections.

- Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated video Lab component/ Practical topics: Applied thermodynamics lab.
- Links: DieselParticulateFilterFundamentalshttps://www.youtube.com/watch?v=aMKpo74P6SE
- Links: Types of Motors used in EVhttps://www.youtube.com/watch?v=6H5vtu5_SF4

Text Books:

1. **Automotive Mechanics,** William H Crouse & Donald L Anglin, 10th Edition Tata McGraw Hill Publishing Company Ltd., 2007.
2. **Automobile engineering**, Kirpal Singh. Vol I and II.

3. **Automotive Mechanics** by S. Srinivasan, Tata McGraw Hill.

Reference Books:

1. **Internal Combustion Engines,** V. Ganesan, McGraw Hill Publication,4th Edition.
2. **Automotive mechanics: Principles and Practices**, Joseph Heitner, D Van Nostrand Company, Inc.
3. **Automobile Engineering**, R.B. Gupta, Satya Prakashan.
4. **Electrical and Electronics Technology**, E. Hughes, Pearson-2010.
5. **Mechatronics Principles & Applications,** by Godfrey Onwubolu, 2006.
6. **Electric Vehicle Technology Explained**, by James Laminie and John Lowry, John Wiley and Sons ltd, 2nd edition 2012.

Web links and video lectures (e-Resources):

1. Fundamentals of Automotive Systems, https://archive.nptel.ac.in/courses/107/106/107106088/

Course Outcomes (COs):

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

1. Understand IC engine, its components, selection of fuels and operation of flex fuels engine. (PO1, PO2, PO3, PO6, PO7, PO12)
2. Analyze different types of carburetors, fuel injection system, turbocharging, supercharging & ignition system to be suitable for CI and SI engines. (PO1, PO2, PO3, PO6, PO7, PO12)
3. Demonstrate different types of power trains and its structure. (PO1, PO2, PO3, PO4, PO6, PO12)
4. Familiarize with different types of automotive chassis, suspension system and brakes. (PO1, PO2, PO3, PO4, PO6, PO7, PO12)
5. Expose knowledge of automotive emission control system, Electrical propulsion system and MEMS. (PO1, PO2, PO3, PO4, PO6, PO7, PO12)

Course Assessment and Evaluation

Continuous Internal Evaluation (CIE)- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3CO-4 & CO-5
Quiz/ Presentation/ Test	10	CO-1, CO-2, CO-3CO-4 & CO-5
Semester End Examination (SEE) - 100 Marks		
Semester End Examination	100	CO-1, CO-2, CO-3, CO-4 & CO-5

FOUNDRY TECHNOLOGY	
Subject Code: MEE734	**Credits: 3:0:0**
Pre requisites: Nil	**Contact Hours: 42 L**
Course Coordinator: Dr. Siddaraju C	

Course Content Unit I

Foundry Metallurgy – Oxidation of Metals, Gas dissolution in liquid Metals, Methods of degassing, Fluidity, factors affecting Fluidity, hot tearing, Shrinkage of liquid metals.
Casting design Introduction, Functional design, Simplification of foundry practice, Metallurgical design, Economical design.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation, animated videos
- Links: -https://freevideolectures.com/course/4760/nptel-metal-casting/15

Unit II

Solidification of Castings – Crystallization and development of cast structure, Nucleation and growth, Dendrite growth, Structure of castings, Significance and practical control of cast structure, Concept of progressive and directional solidification, Refinement and modification of cast structure, Solidification time and Chworinov rule
Risering - Needing for Risering**,** Riser shape, size, Types of risers, Design and location of feeder heads, Design modifications, padding, chills and insulation.

- Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated videos, Demonstration using IC engine models
- Links: -https://freevideolectures.com/course/4760/nptel-metal-casting/25

Unit III

Gating of Castings Essential features of gaiting system, Design of gating system, General aspects of gating practice, Forces acting on the mould.
Special Casting Techniques: Principle, material used, process details and application of Vacuum Process or V-Process Dissamatic moulding or Flaskless moulding
Cupola Melting: -Construction, Preparation and Operation of the cupola, Zones of Cupola Development of Cupola, Charge calculations

- Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated videos
- Links: Refrigeration-https://www.youtube.com/watch?v=O4nsZ8PRQpk

Unit IV

Ferrous foundry-Composition, Properties, applications of Gray Iron, Malleable Iron, SG Iron Production, Magnesium recovery, Heat treatment and properties, application of SG Iron, ADI Production, Properties, application.
Composition, properties, application of Low, Medium, High Carbon Steel, Alloy steels

- Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated videos
- Links: https://www.youtube.com/watch?v=0iezQ4IeXsc

Unit V

Non-ferrous foundry- Introduction, melting procedure, Casting characteristics of Aluminum based alloys, Copper based alloys, Magnesium based alloys.

Modernization and Mechanization - Introduction, need for modernization, mechanization, Elements of Mechanization, Moulding line mechanization, Mechanization of Melting, Pouring and shakeout units. Material Handling equipment's.

❑ Pedagogy/ Course delivery tools: - Chalk and talk, Power point presentation, animated videos ❑ Links-https://www.digimat.in/nptel/courses/video/113105021/L01.html

Text Books:

1. Principles of metal casting by Heine, Loper &Rosenthal, TataMcGrawHill2001.
2. Foundry technology by Beeley.P.R.(Butters worth)2000
3. Principles of Foundry Technology by PL Jain, TMH 2006

Reference Books:

1. Metal casting–ASME handbook 2002
2. Metal casting technology by P.C. Mukerji2002
3. Principles of solidification by B. Chalmers, TataMcGrawHill2001
4. Nonferrous foundry metallurgy by A J Murphy, LLC Publishers 2013.

Web links and video lectures (e-Resources):

1. https://nptel.ac.in/courses/112/103/112103263/
2. https://nptel.ac.in/courses/108/106/108106170/
3. http://www.nptelvideos.in/2012/12/refrigeration-and-airconditioning.html
4. https://youtu.be/7L42aRs68WI
5. http://www.nptelvideos.in/2012/12/robotics.html

Course Outcomes (COs):

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

1. Understand the concepts of foundry metallurgy, casting characteristics, the gating system and the concepts in casting design [PO1, PO2, PO8, PO12, PSO2].
2. Interpret the solidification of pure metal and alloys, special casting techniques, production of ferrous and non-ferrous metals [PO1, PO2, PO8, PO12, PSO2].
3. Recognize the composition, properties and application of ferrous and nonferrous materials [PO1, PO2, PO8, PO12, PSO2].
4. Exercise the charge calculations for melting process and the designing the gating system [PO1, PO2, PO8, PO12, PSO2].
5. Organize the need for modernization and mechanization of foundries [PO1, PO2, PO5, PO8].

Course Assessment and Evaluation

Continuous Internal Evaluation (CIE)- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3CO-4 & CO-5
Quiz/ Presentation/ Test	10	CO-1, CO-2, CO-3CO-4 & CO-5
Semester End Examination (SEE) - 100 Marks		
Semester End Examination	100	CO-1, CO-2, CO-3, CO-4 & CO-5

OPERATIONS MANAGEMENT	
Subject Code: MEE735	**Credits: 3:0:0**
Pre requisites: Nil	**Contact Hours: 42 L**
Course Coordinator: Dr. D K Vishwas	

Course Content Unit I

Operations Management Concepts: Introduction, Historical Development, Operations Management Definition, Production and Manufacturing Systems, Products v/s Services, Productivity, Factors affecting Productivity, International Dimensions of Productivity.

Operations Decision Making: Introduction, Characteristics of decisions; framework for Decision Making, Decision methodology, Decision support systems; Economic models; Statistical models.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- **Links:** https://ivypanda.com/essays/operations-management-9/
- Links: -https://prezi.com/y0ovykwxh1yl/operational-decision-making-tools-decision-analysis/

Unit II

Forecasting: Forecasting Objectives and Uses, Forecasting Variables, Opinion and Judgmental methods, Time Series methods, Simple Exponential smoothing, Regression and Correlation methods, Application and Control of Forecasts.

Supply Chain Management: Introduction, components of supply chain, Process orientation, supply chain structure, Bullwhip effect in supply chains, Contracts and supply chain performance, Measures of supply chain performance.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links: https://pressbooks.senecacollege.ca/operationsmanagement/chapter/forecasting/#:~:text=Forecasting%20is%20the%20process%20of, similar%2C%20but%20more%20general%20term.
- Links: https://www.investopedia.com/terms/s/scm.asp

Unit III

Aggregate Planning and Master Scheduling: Introduction, Planning and Scheduling, Objectives of Aggregate Planning, Pure Strategies of Aggregate Planning. Master Scheduling
- Objectives, Master Scheduling Methods.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links-https://www.brainkart.com/article/Aggregate-Production-Planning-and-theMasterProduction-Schedule_6441/

Unit IV

Material and Capacity Requirements Planning: Overview: MRP and CRP; MRP: Time phasing concepts, MRP inputs and outputs; Bill of Materials; MRP Logic; System refinements CRP inputs and outputs; CRP activities; Infinite and finite loading.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links: -https://www.brainkart.com/article/Aggregate-Production-Planning-and-

the- Master Production-Schedule_6441/

Unit V

Scheduling and controlling production activities: Introduction, PAC objectives and data requirements; forward and backward scheduling; Gantt charts.

Single Machine Scheduling: concepts, measures of performance SPT Rule, Weighted SPT Rule; EDD Rule; minimizing number of tardy jobs.

Multi-Machine Scheduling: Johnson's algorithm, n-jobs to 2-machines, n-jobs to 3-machines, 2 jobs to n machines, Graphical solutions.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links: https://www.planettogether.com/blog/types-of-scheduling-in-production-planning and control
- Links: https://en.wikipedia.org/wiki/Single-machine_scheduling
- Links: https://link.springer.com/chapter/10.1007/BFb0046606

Text Books:

1. Operations Management, B. Mahadevan. Theory and practice, Pearson, 2007
2. Operations Management, Monks, J.G., McGraw-Hill International Editions, 1987.
3. Operations Management, Monks, J.G., Schaum's Outline Series, Tata McGraw Hill Ed. (2004).

Reference Books:

1. Modern Production/Operations Management, Buffa and Sarin, Wiley Eastern Ltd.2001
2. Production and Operations Management, Pannerselvam. R., PHI. 2002
3. Productions & Operations Management, Adam & Ebert. 2002
4. Production and Operations Management, Chary, S. N., Tata-McGraw Hill. 2002

Course Outcomes (COs):

Students will be able to

1. Take a better decision for a given situation**.** [PO1, PO2, PO5, PO11, PO12, PSO1, PSO2]
2. Forecast the future demand from the history**.** [PO1, PO2, PO3, PO5, PO12, PSO1, PSO2]
3. Plan the production satisfying the demand, scheduling accordingly**.** [PO1, PO2, PO11, PO12, PSO1, PSO2]
4. Calculate material required, men and machines required**.** [PO1, PO2, PO3, PO11, PO12, PSO1, PSO2]
5. Schedule properly so that there will be full utilization of men and machines and time taken will be minimum [PO1, PO2, PO5, PO11, PO12, PSO1, PSO2]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) - 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination (SEE) - 100 Marks		
Semester End Examination	100	CO-1, CO-2, CO-3, CO-4 & CO-5

ARTIFICIAL INTELLIGENCE	
Subject Code: MEE736	**Credits: 3:0:0**
Pre requisites: Nil	**Contact Hours: 42 L**
Course Coordinator: Dr. Rajendra P	

Course Content Unit I

Introduction to AI and production systems: Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies, Problem characteristics, Production system characteristics - Heuristic Search Techniques.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links:https://www.youtube.com/watch?v=Aebkfuqj1Og
  https://www.youtube.com/watch?v=wGHrfYMJkuI

Unit II

Knowledge Representation Issues: Representations and Mappings, Approaches to knowledge representation, Issues in knowledge representation. Use of Predicate Logic: Representing simple facts, Instance and ISA relationships, Computable Functions and Predicates, Resolution, Natural deduction.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links:https://www.youtube.com/watch?v=9iN3O_oL2ac
  https://www.youtube.com/watch?v=iqSXLnDt6Lo

Unit III

Knowledge Representation Using Rules: Procedural Vs Declarative knowledge, Logic programming, forward vs. Backward reasoning, matching, Symbolic reasoning under uncertainty: No monotonic reasoning. Implementation Depth First Search and Breadth First Search.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links-https://www.youtube.com/watch?v=upVAC8GttSQ
  https://www.youtube.com/watch?v=_JPEHHhG2tk

Unit IV

Statistical And Probabilistic Reasoning: Probability and Bayes' theorem, Certainty factors and Rule based systems, Bayesian Networks, Shafer Theory, Fuzzy Logic and simple exercises.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links-https://www.youtube.com/watch?v=bY1TRB4ky6o
  https://www.youtube.com/watch?v=hEZjPZ-Ze0A

Unit V

Expert systems: Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics, Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

- Pedagogy/Course delivery tools: - Chalk and talk, Power point presentation
- Links-https://www.youtube.com/watch?v=o0GFC6c_k4g
- https://www.youtube.com/watch?v=l0CRFuA0m_8

Text Books:

1. Artificial Intelligence, Elaine Rich & Kevin Knight, 3rd Ed., M/H 2009.
2. Introduction to AI & ES, Dan W. Patterson, Prentice Hall of India, 1999.

Reference Books:

1. Principles of Artificial Intelligence, Springer Verlag, Berlin, 1981.
2. Artificial Intelligence in business, Science & Industry, Wendy B. Ranch 179
3. A guide to expert systems, Waterman, D.A., Addison – Wesley inc. 1986
4. Building expert systems, Hayes, Roth, Waterman, D.A. Addison – Wesley, 1983

Course Outcomes (COs):

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

1. Understand a AI-Problem formulation and production system concepts. (PO-1, PO-2, PO-3, PSO-1, PSO-2)
2. Solve the concept of knowledge representation issues and the forward, backward reasoning. (PO-1, PO-2, PO-3, PSO-1, PSO-2)
3. Ability to use of predicate logic to represent simple facts and Instances. (PO-1, PO-2, PO-3, PSO-2)
4. Identify a problem in statistical and probabilistic reasoning. (PO-1, PO-2, PO-3, PSO-2)
5. Demonstrate the various learning typical expert system. (PO-1, PO-2, PO-3, PSO-2).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) - 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination (SEE) - 100 Marks		
Semester End Examination	100	CO-1, CO-2, CO-3, CO-4 & CO-5

ROBOTIC AND SIMULATION LABORATORY	
Subject Code: MEL74	**Credits: 0:0:1**
Pre requisites: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. Sunith Babu L	

PART – A (ROBOT SOFTWARE PROGRAMMING)

1. Robot Selection and Work cell creation
2. System Integration for Material Handling / Pick and Place
3. Programming of the robot using the Teach Pendant
4. Pointer Movement using Joint Linear and Circular Movements
5. Robot Program using IF LBL JMP CALL TIMER Functions
6. Robot Program using User Frame
7. Robot Program using Pallet System
8. Robot Program using python (Links, Joints, Forward Kinematics and Inverse kinematics)

PART – B (PROGRAMMING - MATERIAL HANDLING ROBOT)

1. FANUC Robot programming using the following functions, Registry, Position Register, Timer, IF, LBL, JMP, CALL.

Reference:

1) Help Manual of Robo Guide V9.0

Course Outcomes (COs):

Students will be able to:

1) Choose the right robots and set up work areas for tasks like moving materials and picking and placing items. [PO1, PO2, PO3, PO5]
2) Generate a robot program using the teach pendant, making the robots move using different commands. [PO1, PO2, PO5, PO9]
3) Integrate robots with other systems, such as conveyors, to create smooth and efficient automated processes. [PO1, PO2, PO3, PO5, PO9, PO10, PO11]

DATA ANALYTICS & MODELLING	
Subject Code: AEL75	**Credits: 0:1:1:0**
Pre requisites: Nil	**Contact Hours: 28T + 28P**
Course Coordinator: Dr. Rajendra P	

Course Content

Unit-I

Data Analytics with Excel: Formatting of cell values based on data type, importing and exporting of the data, data transformation, nested loop condition, data visualization, matrix operations, Absolute vs Relative Reference, vlookup function

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://www.youtube.com/watch?v=Aebkfuqj1Og
- Lab Component: 1. Import of data, Fundamental Operation in Excel: Sorting, Filtering, Removing Duplicates and formatting based on data types, Sum, average, count, Count if, max and min, V lookup
  2. Matrix operations: Addition, subtraction, multiplication of two matrices, determinant and inverse of a matrix

Unit II

Mechanical Engineering Applications with Excel: Use of formula for Mechanical Engineering problems, data visualization, use of charts and plots: XY scatter, linear plot, curve fit and estimation of R^2, semi log plot, error bars in plots

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://www.youtube.com/watch?v=iqSXLnDt6Lo
- Lab Component: 3. Stress-Strain Curve: Compute Young's Modulus from slope of linear region.
  4. Logarithmic Plot: Plot S-N (fatigue) curve in log-log scale.
  5. Charts and Plots: Types: XY scatter, linear plot, curve fit – determining R^2 of plots, combination plot /chart, semi log plot, error bars in plots.

Unit III

Data transformation and visualization using Python: Dataset import and export, various operations on the dataset creation, sorting, summarizing, updation, deletion, transposing of datasets. use of different functions using Google Colab.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://www.youtube.com/watch?v=upVAC8GttSQ
- Lab Component: 6. Data Import, Data Export, Preparation of charts and Simple mathematical operations using Google Colab.

Unit IV

Machine Learning Models in Mechanical Engineering and Generative AI: Regression models: Linear Regression, Multiple Regression, significance of R^2, logistic regression, validation using

Confusion matrix, overfitting and under fitting models, cross validation. Gen AI for mechanical engineering problems.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: · https://www.youtube.com/watch?v=bY1TRB4ky6o
- Lab Component: 7. Implementing simple linear regression for mechanical datasets.
  9. Evaluating model performance using **R^2 (coefficient of determination).**
  10. Generating confusion matrix for classification tasks.
  11. Demonstrating overfitting and underfitting using polynomial regression or decision boundaries.
  12. Hands-on experience in applying Generative AI tools and frameworks for solving design, analysis, and optimization problems in Mechanical Engineering

Unit V

Modelling of Machine Elements using ANSYS: Application of ANSYS in solving mechanical engineering problems, including modeling and meshing of a connecting rod, bearing block, and analysis of ring deflection.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Links: https://www.youtube.com/watch?v=aShONtHloUk&list=PLbRMhDVUMngcFmWiK1YBhAbsYo8mYvPKJ
- Lab Component: 12. Structural Analysis of connecting rod
  13. Structural Analysis of bearing block 14. Structural Analysis of ring

Text Books:

1. Artificial Intelligence, Elaine Rich & Kevin Knight, 3rd Ed., M/H 2009.
2. Introduction to AI & ES, Dan W. Patterson, Prentice Hall of India, 1999.

Reference Books:

1. Machine Learning and Deep Learning using Python and Tensor Flow, Venkata Reddy Konasani, Mc Graw Hill
2. Python Course Material, D V Analytics
3. Data Scientist Course Material, D V Analytics
4. Step by Step Analysis and Design of High-Rise Building Using ETABS, Dr. Shailendrakumar Dubey, LAP LAMBERT Academic Publishing

Course Outcomes (COs):

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

1. Apply Excel tools to import, transform, and analyze datasets (including mechanical engineering datasets) using advanced functions, conditional formatting, and matrix operations for effective data handling. **(PO1, PO2, PO3, PO4, PO5, PSO1, PSO2)**
2. Develop and interpret engineering charts and plots (XY scatter, curve fitting, semi-log plots, error bars) to analyze and estimate mechanical properties such as young's modulus and fatigue life. **(PO1, PO2, PO3, PO5, PO8, PSO1, PSO2)**

3. Perform data import/export, transformation, summarization, and visualization using Python in Google Colab to automate data analysis workflows. **(PO1, PO2, PO3, PO4, PO5, PSO1, PSO2)**
4. Apply regression and classification models, evaluate their performance using R^2, confusion matrix, and cross-validation, and analyze overfitting and underfitting in mechanical engineering datasets. (PO1, PO2, PO3, PO4, PO5, PO6, PSO1, PSO2**)**
5. Apply ANSYS software tools to model, mesh, and analyze mechanical components such as connecting rods, bearing blocks, and rings, and interpret simulation results for mechanical engineering applications. **(PO1, PO2, PO3, PO4, PSO1, PSO2)**

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) - 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal Test	15	CO1, CO2, CO3, CO4, CO5
Viva	05	CO1, CO2, CO3, CO4, CO5
Lab Component	30	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE) - 50 Marks		
Semester End Examination	50	CO-1, CO-2, CO-3, CO-4 & CO-5

FUNDAMENTALS OF ELECTRIC VEHICLE TECHNOLOGY	
Subject Code: MEOE09	**Credits: 3:0:0**
Pre requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Mr. Nishanth R A	

Course Content

Unit I:

Review of conventional IC engine vehicle –limitations and environmental impact, Introduction to Electric vehicles, Need for electric vehicles, Basic working principle of plug-in EV.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://www.youtube.com/watch?v=_uhDDs5xyoY

Unit II:

Hybrid Electric vehicles – Classification, Layout and Architecture – Series, Parallel and Series Parallel Hybrid, Power train systems, Regenerative Braking.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://www.youtube.com/watch?v=47U1g4ChVkM

Unit III:

Electric vehicle power train- brief outline of electric motor, battery pack, inverter, charger and converter, Electric Motors- AC/DC Motors/ Generators, Brushed DC Motor/ Brushless DC Motor - Torque Characteristics, torque vectoring, switched reluctance motors, induction motors, axial flux motors, Basics of EV suspension system.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://circuitdigest.com/article/different-types-of-motors-used-in-electric-vehiclesev

Unit IV:

Batteries-Types, Lithium-ion battery, Sodium ion battery, Battery management system (BMS): Introduction, Illustration of BMS, battery pack capacity and range, Battery state evaluation: State of charge (SOC), State of health (SOH), State of Life (SOL), Battery Modelling, Challenges encountered in BMS and the possible solutions, Battery recycling: need, market, methods, advantages in current context.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://www.cyient.com/blog/battery-management-system-in-electric-vehicles

Unit V:

EV charging –methods of charging: conductive, inductive and battery swapping, AC charging, DC charging. Fuel cell vehicles – Introduction, Types of fuel cells, Operating principles, Advantages and Drawbacks of fuel cells.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://www.ag-elec.com/understand-various-charging-methods-of-electric-vehicles.html

Text books:

1) James Larminie, John Lowry, ***Electric Vehicle Technology Explained***, John Wiley & Sons Ltd, 2nd ed., 2012
2) K. T. Chau - ***Electric Vehicle Machines and Drives Design, Analysis and Application***- WileyIEEE Press (2015)
3) G A Goodarzi, John G Hayes - ***Electric powertrain _ energy systems, power electronics & drives for hybrid, electric & fuel cell vehicles*** (2018, John Wiley & Sons)
4) Christopher D. Rahn, Chao Yang Wang - ***Battery Systems Engineering,***2013 edition, John Wiley and Sons Ltd.

Reference books:

1) C.C. Chan and K.T. Chau, ***Modern Electric Vehicle Technology***, Oxford University Press, 2001.
   Ali Emadi, ***Handbook of Automotive Power Electronics and Motor Drives***, CRC Press Taylor & Francis Group, 2005
2) Iqbal Hussein, ***Electric and Hybrid Vehicles: Design Fundamentals***, CRC Press Taylor & Francis Group, 2003.

Course outcomes

1. Understand the development of EV technology over the years and also its suitability in different areas of transportation. [PO1, PO3, PO6, PO12 & PSO1]
2. Learn the important components in an EV and hybrid vehicles [PO1, PO9& PSO1]
3. Identify and categorize the different parts and systems necessary for smooth and hassle-free operation of EV [PO1, PO3& PSO1]
4. Reflect upon the need to improve the different parameters in battery management system for safe and reliable operation of battery pack [PO1, PO3, PO5, PO6& PSO2]
5. Learn effective charging methods and compare the performance characteristics of Li ion batteries with that of fuel cells [PO1, PO6, PO7 &PO 12]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE)- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination- 100 Marks		
Semester End Examination (SEE)	100	CO-1, CO-2, CO-3, CO-4 & CO-5

SCIENCE, EDUCATION & TECHNOLOGY FOR RURAL INDIA	
Subject Code: MEOE10	**Credits: 3:0:0**
Pre requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. B P Hari Chandra	

Course Preamble:

Thousands of youths who are studying in engineering colleges are from rural background. After engineering they are desperate to find jobs in cities, since the aspects they would study during any engineering course hardly fit in anywhere, even in case they want to go back to their villages. Further, there is a mindset among the larger student community that if they have to have a bright career, it can happen only in cities. However, there are uncountable number of cases to prove that the other way round is also possible. Hence there is a need to show the options on the other side. This elective course is designed to address the issue.

This course educates the engineering students as to how and what sciences, education and technologies could be adopted in villages and make the students confident enough to think about going back to their villages, have a career in their villages; perhaps a healthier and challenging career than the ones in cities. Thus, the students not only start a career on their own, but also to give employment opportunities to a couple of village youths. This would go a long way in rural development; and urban development too by avoiding overcrowding and mass migration into cities.

SYLLABUS

Unit I

Introduction: Current status of villages in India, village swaraj, basic principles of self sustainable villages, role and potentials of rural economy in the new economic era, Vision of sustainable rural development.

Water management: Water management and water harvesting techniques for villages. Grey water harvesting. Successful case studies of water management.

- ✞ Pedagogy/Course delivery tools:
  - ☐ Chalk and talk, power point presentation
  - ☐ Subject videos
- ✞ Video
  - ☐ https://www.youtube.com/live/u2pvevYr0Y8

Unit II

Sustainable agriculture: Status of Indian agriculture in the past.Sustainable agriculture: principles and strategies, successful case studies. Soil and its fertility management, soil carbon and biochar. Introduction to *Vrukshayurveda*, *Krushi Parashara* and Agro Homeopathy. Career through growing medicinal plants. Cow based economy. permaculture

- ✞Pedagogy/ Course delivery tools:
  - ☐ Chalk and talk, power point presentation
  - ☐ Subject videos

✞ Video https://www.youtube.com/live/u2pvevYr0Y8

✞ Journal Relevance of Ayurveda for organic cultivation of medicinal plants, article Ashwini et. al., Journal of Ayurveda & Integrated medical sciences, Vol.7, No.1, 2022

☐ https://drive.google.com/file/d/1vgRvFTCZDKvf3MUbLpARgrBET7DrmQuZ/view?usp=sharing

Unit III

Power projects: Strategies for utilization of rural biomass. Modules for harnessing biogas. Commercial models of mini power generation, solar power generation and rural needs. Biofuels production. Commercial equipment's.

Education: Scope and options for vocational training, aspects of rural entrepreneurship and career options for engineers.

✞ Pedagogy/Course delivery tools:
- ☐ Chalk and talk, power point presentation
- ☐ Subject videos

Unit IV

Agricultural machinery and processing: The labour problem, need for tiny agricultural machinery, commonly used simple agricultural machinery and implements, micro dairy, processes of value addition for agricultural produce. Tiny technologies for the rural masses.

Role of computers and IoT in rural development.

✞ Pedagogy/Course Chalk and talk, power point presentation delivery tools: Subject videos

Khadi & Village Industries: Motivation from history. Varieties and produces of KVI in India. Scope and importance of khadi and khadi products. Scope for application of current technologies for KVI. Tiny looms.

✞ Pedagogy/Course delivery tools:
- ☐ Chalk and talk, power point presentation
- ☐ Subject videos

Unit V

Model villages: Study of selected role models of villages; viz., solar village, clean village etc.

Need for application of modern technologies in rural areas - brainstorming. **Conceptual mini project:** Conceptual mini project on sustainable village model, power, machinery, processing for value addition of agricultural produce. (A student or a group of 2-3 shall come out with any one of these concepts). The same shall be presented as seminar to the peers. Application of AI

✞ Pedagogy/Course delivery tools:
- ☐ Chalk and talk, power point presentation
- ☐ Subject videos
- ☐ Learning through discussions on the Presentations by students on conceptual models developed.

Text books:

- Village swaraj, M K Gandhi, Navjivan Trust, 2015
- Secrets of fertile soil, Erhard Hennig, Acres, USA, 2015
- Bhageeratha, War on water crisis: Converting dry land into wet land, Ayyappa Masagi, Water Literacy Foundation, 2016
- The Philosophy of Spiritual Farming (Part 1), Subhash Palekar, Subhash Palekar Publications, Amaravati, Maharashtra, 2016
- The Principles of Spiritual Farming (Part 2), Subhash Palekar Publications, Amaravati, Maharashtra, 2016
- SEAT for Rural India, B P Hari Chandra 2021
- Faculty Notes

Journals/Reference:

· Journal of Rural Technology
· Indian Journal of Rural Technology
· Kurukshetra
· Any other journals of relevance

Course objectives:

To teach the students to:

- CO1: Have an understanding the overall past and present status, typical problems and needs of, and availabilities for rural areas especially the water management
- CO2: Understanding the typical problems and the sustainable solutions thereon of yield, soil and in general, the typical aspects of agriculture.
- CO3: understand the aspects pertaining to power production from local resources and vocational training required for the rural masses.
- CO4: Understand machinery and options for value addition of agricultural produce and other technologies to promote rural employment
- CO5: Providing and understanding of the success of model villages and attempt to create conceptual models for more villages

	PO 1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1					1	1					1
CO2		1				2	2					
CO3	2					2	2					2
CO4						1	2				2	2
CO5	1										2	2

Course outcomes:

At the end of the course students:

- CO1: Will have an understanding the overall past and present status, typical problems and needs of, and availabilities for rural areas especially the water management (PO1, PO6, PO7 PO12)
- CO2: Would have understood the typical problems and the sustainable solutions thereon of yield, soil and in general, the typical aspects of agriculture. (PO2, PO6, PO7)
- CO3: will have an understanding of the aspects pertaining to power production from local resources and vocational training required for the rural masses. (PO1, PO6, PO7)
- CO4: would have understood typical machinery and options for value addition of agricultural produce and other technologies to promote rural employment (PO6, PO7)
- CO5: will have an idea and understanding regarding the successful model villages and would be able to attempt to create conceptual models for more villages (PO1, PO11, PO12)

Continuous Internal Evaluation (CIE)- 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1, CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination- 100 Marks		
Semester End Examination (SEE)	100	CO-1, CO-2, CO-3, CO-4 & CO-5