Sant Gadge Baba Amravati University, Amravati

Faculty of Science and Technology

Board of Studies in Mechanical Engineering

Program:	**B. E. Mechanical Engineering**	Semester:	**IV**
Course:	**Material Science** (PCC-I)	Code:	**4ME209PC**

Lecture	Tutorial	Hours	Credit	TA	CT-I	CT-II	Th. Exam	Total
3	0	3	3	40	30	30	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments. Quiz Class, Attendance, etc.

Course Objectives:

1. To study the basic concepts of metallurgy and classification of materials.
2. To study the process of formation of microstructures of metal materials and composites.
3. To study the alloying elements, their effects and applications.
4. To study the ferrous and non-ferrous metals and respective alloys.
5. To study the various heat treatment processes and their industrial applications.
6. To study the case hardening processes and applications of Powder metallurgy.

After completion of the course, the student will be able to understand the:

1. Comprehend the importance of materials in engineering and society.
2. Apply the knowledge of materials science to analyze and solve basic engineering problems related to stress, strain of materials.
3. Select appropriate materials for various engineering applications taking into consideration of issues in cost, quality and environmental concerns.

CO	Course Outcome	BT Level
CO-1	Define basic concepts of metallurgy and classification of materials.	L1
CO-2	Understand the concept of phase & phase diagram & the basic terminologies associated with metallurgy.	L2
CO-3	Explain features, classification and Practical applications of ferrous & nonferrous materials.	L3, L4
CO-4	Explain the classification, microstructure of cast iron sand and its industrial applications.	L4
CO-5	Understand and suggest the heat treatment process & types, significance of properties Vs microstructure.	L4, L2
CO-6	Explain features, classification, applications of the Surface hardening processes and concepts of Powder Metallurgy and its industrial applications.	L3, L2

SYLLABUS

UNIT-I: Introduction to Metallurgy

- Basic concept of process metallurgy, physical metallurgy, and mechanical metallurgy.
- Classification of materials & their applications.
- Structure of metals and alloys, formation of alloys, solid solutions, types, and their formation.
- Lever rule for phase mixtures.
- Solidification of pure metals, nucleation and growth. (6 Hrs)

UNIT-II: Phase Diagrams

- Study of binary equilibrium diagram and invariant reactions.
- Construction and study of Iron-Carbon Equilibrium Diagram.
- Critical temperatures
- Introduction to composite materials, advantages and applications. (6 Hrs)

UNIT-III: Alloy Steels

- Purpose of alloying, classification of alloy steels.
- Effect of alloying elements on eutectoid composition, eutectoid temperature, and the S-curve.
- Properties and applications of Ferritic, Austenitic, and Martensitic stainless steels. (6 Hrs)

UNIT-IV: Cast Irons & Non-Ferrous Alloys

- Constitution and properties of White, Gray, Nodular and Malleable cast irons; their applications.
- Non-ferrous metals and alloys: Brasses and Bronzes. Types of Brasses: Cartridge Brass, Admiralty Brass, Muntz Metal, Leaded Brass, Types of Bronzes: Phosphor Bronze, Aluminum Bronze, Some important alloy of Aluminum: Duralumin, Tin alloy: Pewter and Zinc alloy and its applications.
- Precipitation Hardening and Season Cracking (6 Hrs)

UNIT-V: Heat Treatment of Steels

- Principles of heat treatment: Annealing, Normalizing, Hardening, Tempering.
- Iso-thermal transformation diagrams (S-curve).
- Quenching media, severity of quench.
- Austempering, Martempering, and Patenting. (6 Hrs)

UNIT-VI: Surface Hardening and Powder Metallurgy

- Methods of surface hardening: Carburizing, Nitriding, Cyaniding, Flame & Induction Hardening.
- Mechanical working of metals: Hot and cold working, work hardening, Strain aging, recrystallization, recovery, grain growth.
- Powder Metallurgy: Concept, Advantages, limitations and applications of Powder Metallurgy (6 Hrs)

TEXTBOOKS:

1. Introduction to physical metallurgy ;Sidney H Avner, TATA Mc-Grawhill
2. Engineering materials & metallurgy R.K.Rajput, S chand publication.
3. Material Science & Mettalurgy, by V.D. Kodgire. Everest Publication House.

REFERENCE BOOKS:

1. Mechanical Metallurgy, G. E. Dieter, Mc- Graw Hill International, London 3rd Edn. 1999
2. Physical metallurgy for engineers, Clarke and Varney, second Edn.,1987.
3. Power metallurgy,A.K Sinha First Edn. 1991.
4. Material Science and Metallurgy; V.D. Kodgire; Everest Publishing House
5. Engineering physical Metallugrgy, Y Lakhtin, Mir Publications. Second Ed. 1999
6. Material Science and Meallurgy- C Daniel Yesudian, Scitech Publication

MOOC LINKS:

1. https://onlinecourses.nptel.ac.in/noc22_mm05/preview
2. https://www.coursera.org/learn/introduction-to-materials-science

Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program:	**B. E. Mechanical Engineering**	Semester:	**IV**
Course:	**Material Science (PCC-I)**	Code:	**4ME212PL**

Practical	Hours	Credit	Practical Evaluation		Total
			INT	EXT	
2	**2**	**1**	**25**	**25**	**50**

List of Practical's: - (At least Seven practical's out of the following list.)

1. Study of metallurgical microscope.
2. Study of Iron carbon Equilibrium diagram & Allotropic forms of iron.
3. Study of effect of alloying elements on the properties of steels.
4. Preparation of specimen for micro-examination.
5. Study of micro structures of Annealed and normalized plain carbon steels.
6. Study of micro structures of alloy steels and H.S.S.
7. Study of micro structures of various cast irons.
8. Study of micro structures of non-ferrous metals.(brasses, bronzes)
9. Study of micro structures of hardened and tempered steels.
10. Study different Heat Treatment Process for steel.
11. Study of different surface Hardening processes for steels.
12. Measurement of hardenability by Jiminy end quench test apparatus.
13. Study of hardness tester and conversion of Hardness number
14. Industrial visit to study heat treatment plant.

Practical Examination:

Note : Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program:	**B. E. Mechanical Engineering**	**Semester:**	**IV**
Course:	**Fluid Mechanics (PCC-II)**	**Code:**	**4ME210PC**

Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**CT-I**	**CT-II**	**Th. Exam**	**Total**
03	00	03	03	10	15	15	60	100

Methods of Teacher Assessment (TA): Class Tests, Assignments. Quiz, Class Attendance, etc.

Course Objectives:

1. To give fundamental knowledge of fluid, its properties
2. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow
3. To inculcate the importance of boundary layer flow and its applications
4. To determine the losses in a flow system, flow through pipes, impact of jet

After completion of the course, the student will be able to:

CO	**Course Outcome**	**BT Level**
CO-1	Understand the basic properties of fluid	L-2
CO-2	Understand various forces & conditions of equilibrium of floating & submerged bodies	L-2
CO-3	Understand kinematics and dynamics of flow.	L-2
CO-4	Apply Darcy weisbach equation in various fluid flow	L-3
CO-5	Understand the concept of motion of viscous fluid	L-2
CO-6	Calculate the force exerted by the jet on surfaces	L-2

SYLLABUS

Unit -I Fundamental characteristics of fluid Density, Specific weight, Specific volume, Specific gravity, Viscosity of fluid, Surface Tension, Capillarity, vapour pressure & cavitation.
Pressure & its measurement: Pascals law, Hydrostatic law of pressure & pressure variation in fluid, measurement of pressure by Manometer.

Unit -II Buoyancy & floatation: Concept of buoyancy, Centre of buoyancy. Stability of floating body, Metacenter & metacentric height. Condition of equilibrium of floating & sub-merged body.
Hydrostatic pressure force on plane & Curved surfaces, Measurement of total pressure & Centre of pressure

Unit -III Kinematics of fluid flow, Methods of describing fluid motion, Types of flow, rate of flow, streamline, potential line, flow net, velocity & acceleration, continuity equation in three-dimensional flow.
Dynamics of fluid flow: Eulers equation of motion, Bernoulli's equation measurement of fluid flow with venturi meter.

Unit -IV Flow through pipes: Losses in pipe, major losses, Darcy- Weisbach equation, minor losses due to sudden enlargement, contraction, entry, exit & pipe fitting.
Flow through series & parallel pipes, elementary concept of water hammer in pipes

Unit -V Motion of viscous fluid: Introduction to Laminar & Turbulent flow, Concept of Boundary layer separation & its type, Boundary layer separation.
Reynolds number & its significance. Drag & Lift force on object

Unit -VI: Principle of fluid machinery: Force exerted by fluid jet on plane, curved, stationary & moving vanes. Velocity diagrams, work done & efficiency.
2) Efficiencies Volumetric efficiency, Hydraulic efficiency, Mechanical efficiency and overall efficiency.

TEXTBOOKS:

1. R. K. Bansal, Fluid Mechanics and Hydraulic Machines
2. R. K. Rajput, Engineering Fluid Mechanics
3. Kumar, K.L., Engineering Fluid Mechanics, S. Chand & Company, 2016.
4. R. W. Fox , A. T. McDonald, J. W. Mitchell, Introduction to Fluid Mechanics, Wiley, 2021.
5. Frank M. White, Henry Xue Fluid Mechanics McGraw-Hill; 9th edition, 2022.
6. Modi & Sheth, Fluid Mechanics & Machinery.

REFERENCE BOOKS:

1. S. Ramamrutham, Hydraulic, Fluid Mechanics & Fluid Machines.
2. Fluid mechanics & Machinery by CRSP. Ojha, R. Berndtsson.
3. Kundu, P., Cohen, I., and Dowling, D., Fluid Mechanics, Academic Press, 2015.
4. Streeter, Wylie and Bedford, Fluid Mechanics, McGraw Hill Education, 2017.

MOOC LINKS:

1. https://onlinecourses.nptel.ac.in/noc25_me41/preview
2. https://fm-nitk.vlabs.ac.in/

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Sant Gadge Baba Amravati University,
Amravati Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program:	**B. E. Mechanical Engineering**	Semester:	**IV**
Course:	**Fluid Mechanics (PCC-II)**	Code:	4ME213PL

Practical	Hours	Credit	Practical Evaluation		Total
			INT	EXT	
2	**2**	**1**	**25**	**25**	**50**

List of Experiments: - (At least Seven practical's out of the following list.)

1. Measurement of fluid viscosity
2. Verification of Bernoulli's theorem
3. Determination of the Coefficient of discharge of Orifice-meter.
4. Determination of the Coefficient of discharge of Venturi-meter.
5. Calibration of Rotameter
6. Reynold's experiment to visualize laminar-turbulent transition for flow in a tube
7. Determination of friction factors for the pipes.
8. Measurement of velocity using a pitot tube
9. Determination of Metacentric Height of a floating body.
10. Determination of various minor losses in pipes to compute the total head loss
11. Impact of Jet on flat and curved surfaces

Practical Examination:

Note: Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program:	**B. E. Mechanical Engineering**	**Semester:**	**Fourth**
Course:	**Energy Conversion -I (PCC-III)**	**Code:**	**4ME211PC**

Lecture	**Tutorial**	**Hours**	**Credit**	**TA**	**CT-I**	**CT-II**	**Th. Exam**	**Total**
02	-	02	02	40	30	30	60	**100**

Methods of Teacher Assessment (TA): Class Tests, Assignments. Quiz, Class Attendance, etc.

Course Objectives:

1. To study the properties of steam and its behavior for different thermodynamic processes.
2. To study different types of boilers, their mountings, accessories, performance of boilers and different efficiencies.
3. To study the various fuel handling and ash handling systems in power plant.
4. To study various types of condensers and cooling towers.
5. To study various thermodynamic aspects of flow of steam through nozzle and diffuser.
6. To study flow of steam through steam turbines and concept of compounding.

After completion of the course, the student will be able to:

CO	**Course Outcome**	**BT Level**
CO-1	Understand the concepts of steam, boilers, steam power plant, mounting and accessories.	L2
CO-2	Evaluate the performance of boiler	L3
CO-3	Calculate performance parameters of condenser and nozzle efficiency.	L3
CO-4	Analyze the performance of steam turbines.	L4
CO-5	Compare the various types of nuclear reactors	L2
CO-6	Understand the various renewable energy sources and conversion systems	L2

SYLLABUS

Unit I: Flow diagram for steam power plant with basic units such as steam generator, turbine, condenser and pump. Steam power plant layout, site selection. Boilers: Introduction to water tube and fire tube boilers used in thermal power plants, packaged Boilers, High pressure boilers; Loeffler, Benson, Lamont Boilers, Boiler mountings and accessories—devices for improving Boiler efficiency. Principle of fluidized bed combustion. Concept of cogeneration. (7 Hrs.)

Unit II : Boiler draught; Types of draught, expression for diameter & height of chimney, condition for maximum discharge, efficiency of chimney, reasons for draught loss. Boiler performance:- Boiler rating, boiler power, equivalent evaporation, efficiency. Effect of accessories on boiler efficiency and heat balance. (7 Hrs)

Unit III : CONDENSERS : Need, Types of condensers, quantity of cooling water required. Dalton's law of partial pressure, condenser and vacuum efficiency. Sources of air in condensers and its effect on performance. cooling towers: Natural and mechanical wet type cooling tower.

Steam nozzles : Flow of steam through nozzles & diffusers, Maximum discharge, critical pressure ratio, choking in nozzles, Effect of friction. Determination of throat & exit areas, Nozzle efficiency, no numerical on concept of super saturated flow & Wilson line. (7 Hrs.)

UNIT IV : Steam Turbines:- Principle of working, Types of steam turbines such as impulse, reaction, axial & radial flow, back pressure & condensing turbines. Compounding. Reheat, regenerative cycles, bleeding. Analysis limited to two stages only.

Analysis of steam Turbines : Flow of steam through impulse & impulse reaction turbine blades, Velocity diagrams. work & power developed, axial thrust and efficiency. Governing of steam turbines. (7Hrs)

UNIT V : NUCLEAR POWER:- Fusion, fission, Chain reaction, conversion and breeding in nuclear fission. Components of Nuclear Power Plant such as Reactor, Steam generator, turbine, Moderator, Control Rods etc., Types of nuclear reactors like BWR, PWR, CANDU and liquidized metal cooled thermal reactors. (7 Hrs.)

UNIT VI: Introduction to renewable energy, Wind Energy, solar, fuel cell, bio-gas, Geothermal, OTEC, tidal power plants, Applications of Non-conventional energy. (7 Hours)

RECOMMENDED BOOKS:

TEXTBOOKS :

1. Thermal engineering; Mahesh M Rathore; Tata McGraw-Hill
2. Thermal Engineering R.Yadav; Central publication
3. Non-conventional Energy Sources B. H. Khan Tata McGraw-Hill
4. Non-conventional Energy Sources G. D. Rai.

REFERENCE BOOKS:

1. Steam Turbine; Kearton; Oscar Publications.
2. Thermal Power Engineering; Mathur Mehta; Tata McGraw-Hill
3. Power Plant Engineering. P. K. Nag
4. Power Plant Engineering; R. K. Rajput ; Laxmi Publications
5. Thermal Engineering, P. L. Ballaney; Laxmi Publications.

MOOC LINKS:

1. https://onlinecourses.nptel.ac.in/noc20_me33/preview
2. https://archive.nptel.ac.in/courses/112/107/112107216

Sant Gadge Baba Amravati University, Amravati

Faculty of Science and Technology

Board of Studies in Mechanical Engineering

Program:	**B. E. Mechanical Engineering**	**Semester:**	**IV**
Course:	**Fluid Mechanics and Machines (MDM -II)**	**Code:**	**4ME214M**

Lecture	Tutorial	Hours	Credit	TA	CT-I	CT-II	Th. Exam	Total
02	00	02	02	10	05	05	30	50

Methods of Teacher Assessment (TA): Class Tests, Assignments. Quiz, Class Attendance, etc.

Course Objectives:

1. To give fundamental knowledge of fluid, its properties.

2. To learn the operation, working principle & performance of hydraulic turbines.

After completion of the course, the student will be able to:

CO	Course Outcome	BT Level
CO-1	To Understand the basic properties of fluid & to understand concept of buoyancy and floatation of floating/submerged bodies	L-2
CO-2	Demonstrate and understand the working of hydraulic turbines	L-2
CO-3	Demonstrate and understand the working of centrifugal pumps and reciprocating pump	L-2

SYLLABUS

Unit -I Basic characteristics of fluid -Density, Specific weight, Specific volume, Specific gravity, Viscosity of fluid, Surface Tension, Capillarity. Buoyancy & floatation: Concept of buoyancy, Centre of buoyancy

Unit -II. **Hydraulic Turbines** - Theory of impulse and reaction turbines. Pelton wheel Turbine Francis and Kaplan turbines, their construction, classification

Unit -III VI Centrifugal pumps :- Basic Theory, classification, construction, operation,
Reciprocating pump:- Basic Theory, classification, construction, operation

TEXTBOOKS:

1. Fluid Mechanics and Hydraulic Machines by R. K. Bansal
2. Engineering fluid Mechanics by R. K. Rajput
3. CSP Ojha, R. Berndtsson, Fluid mechanics and machinery; Oxford University.

REFERENCE BOOKS:

1. Hydraulic, Fluid Mechanics & Fluid Machines, S. Ramamrutham.
2. Fluid Mechanics & Machinery by Modi & Sheth
3. Dr. Modi & Seth, Hydraulics and Fluid Mechanics; Standard house book

MOOC LINKS:

1. https://onlinecourses.nptel.ac.in/noc25_me41/preview
2. https://onlinecourses.nptel.ac.in/noc25_me89/preview
3. https://onlinecourses.nptel.ac.in/noc25_me38/preview

Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program:	**B. E. Mechanical Engineering**	**Semester:**	**IV**
Course:	**Computational Methods and Programming**	**Code:**	**4ME215VS**

Lecture	Practical	Total Hours	Credit	IE (Practical)	EXT (Practical)	Total
01	02	03	02	50	--	50

Methods of Internal Evaluation (IE): Class Tests, Assignments, Quiz, Class Attendance, etc.

Course Objectives:

This course provides an introduction to the numerical methods to solve various kinds of equations that students encounter in the field of mechanical engineering, energy and transportation. The emphasis should be more on programming techniques rather than the language itself.

1. To understand the importance of obtaining approximate solutions to various practical problems.
2. To introduce some of the key computational techniques used in modelling and simulation of engineering problems.

After completion of the course, the student will be able to:

CO	Course Outcome	BT Level
CO-1	Apply fundamental programming constructs to solve numerical problems and calculate errors associated with computational methods.	L2
CO-2	Solve linear algebraic equations using numerical techniques.	L3
CO-3	Estimate solution to problems using numerical integration and differentiation.	L3
CO-4	Apply computational schemes for solving systems of ordinary differential equations.	L3

SYLLABUS:

Unit - I

Basics of scientific computing: Introduction to numerical computation and computer programming. General programming principles, Approximations and Types of errors; Taylor series and error propagation, Stability; Accuracy.

Unit - II

Numerical Methods in Linear Algebra: Direct and iterative solution techniques for simultaneous linear algebraic equations - Gauss elimination, and Gauss-Seidel iterative techniques for solving linear systems, interpolation and Lagrange polynomial, curve fitting - regression analysis, Root finding- simple methods, Engineering applications, Implementation in C++/Python/Matlab/etc.

Unit- III

Numerical differentiation & Integration: Numerical differentiation using forward-difference formula, elements of numerical integration, the trapezoidal rule, Simpson's rules.

Unit- IV

Ordinary differential equations (ODEs): Introduction to ODEs – Initial Value problems, Euler method for solving initial-value problems, Runge-Kutta method, simulating a simple pendulum.

Introduction to partial differential equations (PDEs): Finite difference method for solving PDEs, finding a root using the bisection method, fixed-point iteration, Newton's method.

List of Programs: At least **06** programs should be developed from the topics of the syllabus, as suggested below. Emphasis should be on developing own generic programmes using any programming language such as MATLAB/Python/C++ and use of available functions should be avoided. It should enhance student's ability to develop mathematical models and solve real-world problems using computational methods.

1. Program to solve a system of linear equations using Gauss elimination method.
2. Program to solve a system of linear equation using Gauss-Seidel method.
3. Program to find real root of a polynomial using Newton Raphson Method.
4. Program to find real root of a polynomial using fixed point iterative method.
5. Development of computer program for Numerical integration by Trapezoidal.
6. Development of computer program for Numerical integration by Simpson's rule.
7. Program to solve problem involving curve fitting and interpolations.
8. Program to find the value of function using Newton Forward Difference Method
9. Program to solve initial value problem using Euler Method.
10. Program to find solution of initial value problem using Runge-Kutta method.

TEXTBOOKS:

1. Shastry, S.S., Introductory Methods of Numerical Analysis, Prentice Hall Inc., India, 2012.
2. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall of India, 4th Ed. 2019.
3. M.K. Jain, S. R. K. Iyengar, and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age Publication, 6th Ed. 2012.
4. Steven Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill, 5th Ed., 2023.
5. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 8th Ed, Tata McGraw Hill, 2021.
6. T Veerarajan, T Rama Chandran, Theory and Problems in Numerical Method, Tata McGraw Hill Co-Ltd, 2018.

REFERENCE BOOKS:

1. S. D. Conte and C. de Boor, Elementary Numerical Analysis, Third Edition, Tata McGraw-Hill Education, 2005.
2. J. D. Hoffman, Numerical Methods for Engineers and Scientists, Second Edition (Special Indian Edition), CRC Press, 2001.
3. K. E. Atkinson. An Introduction to Numerical Analysis, Second Edition, Wiley, 2008.

Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program:	**B.E. Mechanical Engineering**	**Semester:**	**Fourth**
Course:	**Business Planning and Project Management**	Code:	**4ME216OE**

Lecture	Tutorial	Hours	Credit	TA	CT-I	CT-II	ESE	Total
2	**0**	**0**	**2**	**10**	**5**	**5**	**30**	**50**

Methods of Teacher Assessment (TA): Class Tests, Assignments, Quiz, Class Attendance etc.

Course Objectives:

1. To study the concept of business planning and forecasting.
2. To learn the importance of project planning and selection criteria.
3. To study the concepts of project appraisal and report writing.

Course Outcomes:

After completion of the course, the students will be able to –

CO	**Course Outcomes**	**BT Level**
CO1	Understand the concept of Business Planning and forecasting and other planning aspects in business.	L-1
CO2	Understand the importance of project planning and critically examine which project needs to be undertaken using various models.	L-2
CO3	Understand and apply the knowledge of project appraisal and project report writing.	L-3

SYLLABUS

Subject: Business Planning and Project Management **L**

UNIT I

Business Planning: Introduction, Definitions, Nature and characteristics of planning, Objectives of planning, Importance of planning, Steps in planning process, Essentials of a good planning, Advantages and limitations of planning, Elements of Business Plan 9

Planning Forecasting: Introduction to Forecasting, Scope of

	forecasting**,** Forecasting techniques/Types/ Methods, Advantages, disadvantages of forecasting	
UNIT II	**Introduction to Project Management**: Project Lifecycle, Project selection and evaluation, Selection criteria and models, Project proposals. **Project Planning:** Identifying the Project area and target group, Determining the goals and objectives of the Project, Project work plan and time frame: Preparation of action plan and time schedule (GANTT charts), Assessing the feasibility and viability of the Project, Project Appraisal techniques	8
UNIT III	**Project Appraisal:** SWOT analysis, Cash flow analysis, Payback period and Net present value, Steps in Project Appraisal Process, Types of appraisals. **Developing a Project Plan**: Developing the Project Network, Constructing a Project Network (Problems) using PERT and CPM, Resource Leveling and Resource Allocation, Project Control Process, Control Issues, Project Audit Process. **Report Writing:** Preparation and Submission of final project report, Communication and presentation of report.	9
	Total	26

TEXTBOOKS:

1. K. Ashwathappa and Siddharth Bhat, Production and Operation Management: , Himalaya Publishing House, 2010
2. Shubhangi Kulkarni, Business Planning and Project Management, Vision Publications
3. Prasanna Chandra, Projects.(2002). Planning, Analysis, Financing, Implementation and Review, Tata MC Graw Hill publishing Company Ltd, New Delhi.

REFERENCE BOOKS:

1. Arun Kanda, PROJECT MANAGEMENT, PHI, Delhi, 2011
2. Nagarajan. K. (2001). Project Management, New age international (P) Ltd. New Delhi.
3. Vasant Desai. (1997). Project Management, Himalaya publishing house, Mumbai.
4. John M. Nicholas (2005), Project Management for Business and technology: Principles and Practice, Pearson Prentice Hall, New Delhi.
5. Bhavesh M Patel. (2000). Project Management, Vikas Publishing House Pvt. Ltd., New Delhi.

Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program	**B.E. Mechanical Engineering**	**Semester**	**IV**
Course	**Open Elective- II: Sustainable Energy**	**Code**	**4ME216OE**

Lecture	Tutorial	Hours	Credit	TA	CT-I	CT-II	Th. Exam	Total
2	0	0	2	10	5	5	30	50

Method of Teacher Assessment (TA): Class Tests, Assignments, Quiz, Class Attendance, etc.

Course Objectives:
To understand the basic concept of Sustainable Energy e.g. Solar Energy, P-V Cell, Geothermal Energy, Tidal Energy, Ocean Thermal Energy Conversion, Wind Energy, Biomass Energy Conversion

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

CO	**Course Outcomes**	**BT Level**
CO 1	Understand the basic concept of Sustainable energy, Sources and its importance, radiation transmission through covers and solar energy collections, the basic concept of Solar energy utilization and storage.	L2
CO 2	Understand the basic concept of Geothermal energy, energy from ocean.	L2
CO 3	Understand the basic concept of energy from Wind and biomass.	L2

SYLLABUS:

UNIT I:
Introduction: -Sustainable energy. Need of sustainable energy sources, Overview of Global and Indian Energy Scenario.
Solar Radiation: Types of Solar radiation, Measurement of solar radiation using Pyrheliometer, Pyranometer and Sunshine Recorder.
Solar Collectors: classifications of collectors, construction and working.
Solar Energy Storage & Utilization: Methods of storage, Applications of solar energy in heating, cooling, pumping, power production, distillation, drying, etc.
Solar Photo voltaic cells: Principle, Construction and Working (8Hrs)

UNIT II:
Geothermal Energy Resources: Hot Dry Rock system, Vapour dominated, liquid dominated, flash steam, binary fluid concept of power generation.
Tidal Power: Types of tidal plants such as single and two basin plants, operation of tidal power plant.
Ocean thermal energy conversion system: Construction and working of OTEC systems (8Hrs)

UNIT III:

Wind Power: Introduction, Principles of wind energy conversion, Operation, Wind speed data, Site selection, Types of windmills, Applications.

Biomass Energy Resources: Mechanism of green plant photosynthesis. Solar energy plantation,

Biogas-Types of biogas plants, factors affecting production rates. Introduction to biodiesel and ethanol as alternative fuels, properties of bio-fuel. (8 Hrs)

BOOKS RECOMMENDED:

TEXTBOOKS:

1. Solar Energy; S.P. Sukhatme; TMH.
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications.
3. Non-Conventional Energy Sources; B. H. Khan.

REFERENCE BOOKS:

1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons.
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication.
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai.
4. Renewable Energy Sources and Emerging Technology; D.P. Kothari, K.C. Singal, Rakesh Ranjan; PHI.

MOOC Links:

Renewable Energy Engineering: Solar, Wing, Biomass Energy Systems: https://archive.nptel.ac.in/courses/103/103/103103206/

Non-Conventional Energy Sources: https://archive.nptel.ac.in/courses/121/106/121106014/

Hydro and Renewable Energy: https://nptel.ac.in/courses/109107397

Sant Gadge Baba Amravati University, Amravati
Faculty of Science and Technology
Board of Studies in Mechanical Engineering

Program:	**B.E. Mechanical Engineering**	**Semester:**	**Fourth**
Course:	**Automotive Technology**	**Code:**	**4ME2160E**

Lecture	Tutorial	Hours	Credit	TA	CT-I	CT-II	Th. Exam	Total
2	0	2	2	10	5	5	30	50

MethodsofTeacherAssessment(TA): ClassTests,Assignments.Quiz,ClassAttendance,etc.

Course Objectives: To understand……..

After completion of the course, the student will be able to:

CO	Course Outcome	BT Level
CO-1	Understand the basics of automobile engineering and its components.	L1
CO-2	Understand the basics of Control system and transmission system	L1
CO-3	Get aquatinted with the recent developments of electric and Hybrid Vehicles.	L1

Syllabus

Unit-I **: Power Unit and Fuel Supply System** :Classification of automobiles, chassis layout types, Engine parts- types, construction and functions, Multiple cylinder engines, components of fuel supply system, M.P.F.I. and C.R.D.I (8 Hrs)

Unit-II : **Control and Transmission System** : Braking system:- Mechanical, Hydraulic and Air brake system, Steering system:- Layout, steering gears, Power steering- Principle and working. Transmission system : Layout, multiplate clutches, synchromesh gear box, Automatic gear box and Differential (8-Hrs)

Unit-III: **Electric & Hybrid Vehicles :** Electric components used in hybrid and electric vehicles and their functions, Configuration and control of DC and Induction Motor drives, Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Hybridization of IC engines and electric motors. (8 Hrs)

TEXTBOOKS:

1. Automobile Engineering-Vol -I &II, Kirpal Singh, Standard Publishers Distributors
2. Automobile Engg. By K. M. Gupta.l, Vol. -I & II, Umesh Publications
3. Automobile Engineering –R. K. Rajput; Laxmi publications, New Delhi.
4. Fundamentals of Hybrid and Electric Vehicles - K. C. Jain , Dr. Amit R. Patil , Dr. Arvind J. Bhosale, Dr. S.S. Raghuvanshi
5. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.

REFERENCE BOOKS:

1.Automotive Mechanics; Crouse & Anglin, TMH.
2.Automotive Mechanics ; S. Srinivisan; TMH.
3.James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

MOOC LINKS:

1. https://cursa.app/en/free-course/fundamentals-of-automotive-engineering-ciee
2. https://alison.com/course/mechanical-engineering-internal-combustion-engine-basics#google_vignette
3. https://www.edx.org/cour se/electric-carsintroduction-0
4. https://www.edx.org/cour se/electric-andconventional-vehicles-4
5. https://www.edx.org/cour se/hybrid-vehicles-1