

JHARKHAND RAI UNIVERSITY

MECHANICAL ENGINEERING

B.Tech

SYLLABUS 2018-2022

SEMESTER V

Kamre | Ratu Road | Ranchi | Jharkhand

Web : www.jru.edu.in | Email : info@jru.edu.in

BATCH 2018-2022												
B.Tech in MECHANICAL ENGINEERING												
Choice Based Credit System												
SEMESTER V												
S.No.	CATEGORY	CODE	COURSE TITLE	Periods			Evaluation Scheme				Subject Total	Credit
				L	T	P	Assign ment	TA	Total	ESE		
1	Professional Core Courses	7PCCME301	Heat Transfer	3	1	0	20	10	30	70	100	4
2	Professional Core Courses	7PCCME302	Solid Mechanics	3	1	0	20	10	30	70	100	4
3	Professional Core Courses	7PCCME303	Manufacturing Processes	3	0	0	20	10	30	70	100	3
4	Professional Core Courses	7PCCME304	Kinematics & Theory of Machines	3	1	0	20	10	30	70	100	4
5	Mandatory Courses	MC301	**Constitution of India	2	0	0	20	10	30	70	100	0
6	Humanities and Social Sciences including Management Courses	HSMC301	**Professional Skills	2	0	0	20	10	30	70	100	0
PRACTICAL /SESSIONAL												
1	Professional Core Courses	7PCCME305P	Mechanical Engineering Laboratory I	0	0	3			30	20	50	1.5
2	Project (Summer Internship)	7PROJME306	Project I	0	0	2		75	75	25	100	2.5
										TOTAL	750	19

** NOTE: Qualifying Non Credit Course)

Subject Code	Subject	L	T	P	C
7PCCME301	Heat Transfer	3	1	0	4

Course Objectives:

- The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Contents:

Module I

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer- approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Module II

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer- Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Module III

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ϵ -NTU methods.

Module IV

Boiling and Condensation heat transfer, Pool boiling curve .Introduction mass transfer, Similarity between heat and mass transfer.

Course Outcomes: After completing the course

- The students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
- The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.
- The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Text Books:

- A. Bejan, Heat Transfer John Wiley, 1993.
- J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
- F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
- Massoud Kaviany, Principles of Heat Transfer, John Wiley,2002.
- Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill,2002.

Reference Books:

- Y.A. Cengel and AFSHIN J GHAJAR, "Heat and Mass transfer, Fundamental and Application". F. P.
- Incropera and D. P. De Witt, "Fundamentals of Heat Transfer", John Wiley and Sons, New York (1996).

Subject Code	Subject	L	T	P	C
7PCCME302	Solid Mechanics	3	1	0	4

Course Objectives:

- The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.
- To solve solid mechanics problems using theory of Elasticity.
- To solve advanced solid mechanics problems using classical methods.

Course Contents:

Module I

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions.

Module II

Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.

Module III

Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, ax symmetric problems.

Module IV

Application to thick cylinders, rotating discs torsion of non-circular cross-sections, stress concentration problems. Solutions using potentials. Energy methods. Introduction to plasticity.

Course Outcomes: After completing the course

- To understand the theory of elasticity including strain/displacement and Hooke's law relationships; and, to apply various failure criteria for general stress states at points.
- To analyze thick cylinders and understand the practical application.
- To analyze solid mechanics problems using classical methods and energy methods.

Text Books:

- G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
- Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
- Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

Reference Books:

- Advanced Mechanics of Solids by L S Srinath.
- Elasticity: Theory, Applications, and Numerics by Martin H. Sadd.

Subject Code	Subject	L	T	P	C
7PCCME303	Manufacturing Processes	3	0	0	3

Course Objectives:

- To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.
- To understand basic manufacturing processes like casting, welding and metal forming.
- To learn various aspects of different manufacturing techniques such as various casting methods, welding methods and metal forming methods.
- To decide which manufacturing technology can be implemented for a specific product.
- To learn basic metal removal processes and different tools used in them.
- To learn mechanics and mechanism of machining, tool life, tool materials, heating effect in machining, machining time and economy of machining process.
- To learn different machine tools and gigs and fixtures used in them

Detail Contents:

Module I

Conventional Manufacturing processes:

Casting and molding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Module II

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Module III

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Module IV

Additive manufacturing: Rapid prototyping and rapid tooling. Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Module V

Unconventional Machining Processes:

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

Course Outcomes: After completing the course

- Students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products.
- In welding technology students will have a generalized knowledge on various welding technology used in manufacturing.
- In metal forming processes the students will have knowledge on stress and strain analysis and various yielding methods to understand the analysis of metal forming processes.
- The students basically going to learn machining processes and machine tool.
- The student will be able to select between a subtractive and an AM process for a particular application. He or she will be able to select a particular AM process.
- The student will be able to take a career in research or in advanced manufacturing, the AM being a rapidly evolving area and with wide applications.
- It is aimed at making the students ready for product development of engineering components and for entrepreneurship.
- To categorize the various advanced manufacturing process based on energy sources and mechanism employed.
- To select the best suitable advanced manufacturing process for processing of different work piece materials.

Text Books:

- Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
- Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
- Degarmo, Black & Kohser, Materials and Processes in Manufacturing.

Reference Books:

- Pandey P. C. and Singh C. K., Production Engineering Sciences, Standard Publisher.
- Jain R.K., Production Technology, Khanna Publisher.
- Kalpakjian S., Schemid S., Manufacturing, Engineering and Technology, Addison Wesley.
- Rao P. N., Manufacturing Technology I, Tata McGraw Hill.
- Ghosh A. and Mallik A. K., Manufacturing Science, EWP Pvt. Ltd.

Subject Code	Subject	L	T	P	C
7PCCME304	Kinematics & Theory of Machines	3	1	0	4

Course Objectives:

- To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
- To be able to design some linkage mechanisms and cam systems to generate specified output motion.
- To understand the kinematics of gear trains.
- This course will give insight into different mechanisms, degree of freedom and kinematic synthesis of mechanism.
- It will help to understand bearings, brake, clutch, different types of dynamometer.
- To understand different types of gears and gear trains and how interference and undercutting occurs in gears.

Detail Contents:

Module I

Classification of mechanisms-Basic kinematic concepts and definitions-Degree of freedom, mobility-Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit Positions -Mechanical advantage-Transmission angle-Description of some common mechanisms-Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms.

Module II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations-kinematic analysis of simple mechanisms- slider crank mechanism dynamics-Coincident points-Coriolis component of acceleration- introduction to linkage synthesis- three position graphical syntheses for motion and path generation.

Module III

Classification of cams and followers-Terminology and definitions-Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions-Specified contour cams- circular and tangent cams - pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers .

Module IV

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes.

Course Outcomes: After completing this course

- The students can design various types of linkage mechanisms for obtaining specific motion and analyze them for optimal functioning.
- Both analysis and Synthesis are useful in obtaining desired relative motion for specific engineering purpose like motion of automobile and operations of lathe machine.
- Student will calculate the power lost due to friction in bearings and braking torque value in brakes.
- Student will able to find out displacement of follower and able to draw cam profile.

Text Books:

- Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
- Cleghorn W.L. , Mechanisms of Machines, Oxford University Press, 2005.
- Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
- Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

Reference Books:

- Theory of machine by R.S Khurmi
- Theory of machine by SS Rattan
- Theory of machine by R.k Bansal

Subject Code	Subject	L	T	P	C
MC301	**Constitution of India	2	0	0	0

Course Objective:

The basic object of the course is to provide the acquaintance with the basic features of Indian Constitution e.g. Fundamental Rights, Fundamental Duties and Directive Principles of State policy Further it is aimed to impart the knowledge about Judicial system in India.

Module I

1. Nature of Indian Constitution
2. Preamble
3. Union and its Territory (Arts1-4)
4. Citizenship (Arts5-11)
5. Definition of State (Art12)

Module II

1. Judicial Review (Article13)
2. Right to Equality (Article14)
3. Prohibition on grounds of Religion, Race, Caste, Sex, Place of Birth (Article15)
4. Equality of Opportunity in Public Employment (Article16)
5. Abolition of Untouchability and Titles (Articles17-18)

Module III

1. Basic freedoms (Article 19)
2. Protection in respect of conviction for offences (Article20)
3. Right to Life and Personal Liberty (Article21)
4. Safeguards against arbitrary arrest and detention (Article22)

Module IV

1. Right against exploitation (Articles23-24)
2. Freedom of Religion (Articles25-28)
3. Cultural and Educational Rights of Minorities (Articles 29-30)
4. Constitutional Remedies (Articles32-35)

Module V

1. Directive Principles of State Policy and their relation with Fundamental Rights (Articles36-51)
2. Fundamental Duties (Article 51-A)
3. Right to Property (Article300-A)
4. Facts and Law laid down in Maneka Gandhi V Union of India AIR 1978SC597
5. Facts and Law laid down in Indira Sawhney V Union of India AIR 1993 SC 477

Course Outcome:

- To Know the Human rights and concept of women empowerment.
- To know features of our constitution.
- Practice the moral values that ought to guide the Engineering profession.
- Discover of the set of justified moral principles of obligation, ideals that ought to be endorsed by the engineers and apply them to concrete situations.
- Know the definitions of risk and safety also discover different factors that affect the perception of risk.
- Appreciate the Ethical issues and Know the code of ethics adopted in various professional body's and industries.
- Justify the need for protection of human rights and to know about concept of women empowerment.
- Know the successful functioning of democracy in India.

Text Books:

- Austin Granville- the Indian constitution: Cornerstone of a Nation.
- Seervai H.M. - Constitution of India
- Jain M.P. – Indian Constitutional Law
- Shukla V N- Constitution of India (Ed. By M.P.Singh)
- Basu D.D. – Shorter Constitution of India

Reference Books:

- **Introduction to the Constitution of India by Durga Das Basu.**
- **Indian Polity by M Laxmikant TataMc Hill.**

Subject Code	Subject	L	T	P	C
HSMC301	**Professional Skills	2	0	0	0

Course Objective:

The objectives of the course are:

- To make the student understand the role of communication in personal & professional success.
- To develop awareness of appropriate communication strategies.
- To prepare and present messages with a specific intent.
- To analyze a variety of communication acts.
- To ethically use, document and integrate sources.
- To create a basic awareness about the significance of soft skills in professional and inter-personal communication.
- To facilitate an overall development of the personality.

Module I: Personal Development

Managing Self - Self Discovery, Self Awareness, Self Esteem, Self Responsibility, Self Management
 Personal Development Skills, Categories of Personal Development, Personal Development Process
 Relationship Management - Managing Others, Interpersonal Skills, Improving Relationship,
 Transactional Analysis, JOHARI Window, four Life Positions

Module II: Thinking Process

Strategic Thinking – Introduction, Concept, Stages in Strategic Thinking, Process of Strategic Thinking, Importance of Strategic Thinking, Characteristics of Strategic Thinkers, Developing Strategic Thinking.

Lateral Thinking – Introduction, Meaning, Need for Lateral Thinking, Techniques of Lateral Thinking, Benefits of Lateral Thinking

Creative Thinking – Out of Box Thinking, Application of Thinking

Facing Changes – Adapting Change, Understanding Change- Examples of Organizational Change
 Facing Challenges – Introduction, Taking Initiative, Benefits of facing challenges, facing challenges in life.

Balancing Work and Life – Importance, Gender differences regarding work life balance, Tips for balancing work and life

Module III: Individual Behavior

Attitude – Components of Attitude, Factors influencing Attitude, Types of Attitude, Challenges and lessons from Attitude, Impact of Attitude on Behavior

Motivation – Concept, Objective, Factors of Motivation, Self Esteem, Intrinsic & Extrinsic Motivation

Time Management – Value of Time, Diagnosing Time management, Weekly Planner, To Do List, Prioritizing Work.

Stress Management – Introduction, Difference between Stress, Anxiety and Tension, Managing Stress

Applied Ethics – Introducing Professional Ethics, Ethical Dilemma

Module IV: Employment Communication

Job Communication – Developing Job Communication Skills, Job Communication Process, Developing Confidence

Job Search Strategy – Understanding the Job Market, the Job Search Process, Job Search Techniques

Job Application, Employment Letters

Resume Building – Difference between Bio data, Curriculum Vitae and Resume

The Job Interview - Types of Job Interview, Preparing for a Job Interview, Understanding Interview Questions, Handling Interview Questions, Interview Strategies Psychometric Test.

Course Outcome:

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

- Students will identify their goals.
- Differentiate self-serving bias, confirmation bias, and fundamental attribution error.
- Identify and explain how social relationships vary in handling important communication behaviors and conflict.
- Be able to seek and secure professional opportunities.
- Develop professional competency.

Suggested Readings:

1. Covey S (2004) the 7 Habits of Highly Effective People.
2. Goud, N. & Arkoff, A. (2003) Psychology and Personal Growth, Allyn & Bacon.
3. Sen, Leena, Communication Skills, Eastern Economy Edition
4. Dr. K. Alex Managerial Skills, S. Chand

Subject Code	Subject	L	T	P	C
7PCCME305P	Mechanical Engineering Laboratory I	0	0	3	1.5

Objectives:

- To understand the principles and performance characteristics of flow and thermal devices
- To know about the measurement of the fluid properties

Contents:

- Measurement of Coefficient of Discharge of given Orifice and Venturimeters
- Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
- Determination of the performance characteristics of a centrifugal pump
- Determination of the performance characteristics of Pelton Wheel
- Determination of the performance characteristics of a Francis Turbine
- Determination of the performance characteristics of a Kaplan Turbine
- Determination of the thermal conductivity and specific heat of given objects
- Determination of the calorific value of a given fuel and its flash & fire points
- Determination of the p-V diagram and the performance of a 4-stroke diesel engine
- Determination of the convective heat transfer coefficient for flow over a heated plate
- Determination of the emissivity of a given sample
- Determination of the performance characteristics of a vapour compression system

Course Outcomes:

The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery.

Subject Code	Subject	L	T	P	C
7PROJME306	Project I	0	0	2	2.5

Course Objectives:

This course is aimed to provide more weight age for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.