Course Code: BAC-C102/C202
Course Name: Engineering Chemistry

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	**Engineering Chemistry**
Objectives:	1. To acquire knowledge about the periodic properties, oxidation number, hydrogen bonding and hybridization. 2. To understand the general concepts of thermodynamics, chemical kinetics and acid-base equilibrium. 3. To gain the knowledge of polymers, conducting polymers, synthesis, properties and uses of some common polymers, nylons and rubbers. 4. To learn the significance of Nano chemistry and different approaches to synthesis of Nanoparticles. 5. To understand the organic reactions like addition reactions, elimination reactions, substitution reactions and oxidation-reduction reactions. 6. To understand the synthesis of some common drugs like Aspirin, Phenacetin & Paracetamol.
Course Coordinator	**Dr. Ajay Kumar**

NOTE:	The question paper shall consist of two sections (Sec.-A and Sec.-B). Section-A shell contains ten short type questions of six marks each and the student shall be required to attempt any five questions. Section-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT	Module	Course Content	No. of Hours	POs mapped
UNIT-1	*Module-1*	Shielding and effective nuclear charge, Penetration of orbitals, Division of elements into s, p, d and f blocks, Variation of s, p, d and f orbital energies of atoms in the periodic table, Atomic and Ionic sizes, Ionization potential, Electron affinity, Electronegativity, Dipole moment, Polarizability.	**05**	PO1/ PO2/ PO3/ PO4/ PO5…
	Module-2	Oxidation states, Coordination numbers and geometries, Hydrogen bonding, Concept of hybridization.	**03**	PO1/ PO2/ PO3/ PO4/ PO5…
UNIT-2	*Module-3*	Introduction, Rate of reaction, Factors influencing rate of reaction, Rate law and reaction order, Differentiate between molecularity and reaction order, Arrhenius equation, Activation energy and its determination, Transition state theory of reaction rates.	**04**	PO1/ PO2/ PO3/ PO4/ PO5…
	Module-4	Thermodynamic functions: Energy, Enthalpy, Entropy and Free energy, Physical significance of entropy, Estimations of entropy and free energies, Free energy and emf, Cell potentials, Nernst equation and applications (without derivation) Acid-base, solubility and solubility product.	**04**	PO1/ PO2/ PO3/ PO4/ PO5…
UNIT-3	*Module-5*	Basic concepts of polymers, Classification of polymerization, Industrial applications of polymers, Differentiate between (i) Addition and condensation polymers, (ii) Thermoplastic and thermosetting polymers, Elementary idea of biodegradable and conducting polymers.	**06**	PO1/ PO2/ PO3/ PO4/ PO5…
	Module-6	**Plastics:** Synthesis, properties and uses of Polyvinyl chloride (PVC), Polytetrafluoroethylene (PTFE)/Teflon, Polymethyl methacrylate (PMMA), Bakelite. **Nylons:** Introduction to Nylons, Preparation, properties and	**02**	PO1/ PO2/ PO3/ PO4/ PO5…

		uses of Nylon 6, and Nylon 6,6. **Rubbers:** Natural rubber and synthetic rubber, Vulcanization of rubber, Advantages of vulcanized rubber.		
UNIT-4	*Module-7*	Introduction, Characteristic properties of nanomaterials, Synthesis of nanomaterials (Top-down and bottom-up approach), Introduction, properties and applications of Fullerenes (C60), Carbon nanotubes (CNT's), Nanorods and Nanowires, Applications of nanomaterials in Medicine, Energy science, Bio-sensors, Electronics, Catalysis and Fabrics.	**08**	PO1/ PO2/ PO3/ PO4/ PO5…
UNIT-5	*Module-8*	Introduction to reactions involving Addition, Elimination, Substitution and Oxidation and Reduction. Isomerism: Basic concept of geometrical and optical isomerism.	**06**	PO1/ PO2/ PO3/ PO4/ PO5…
	Module-9	Definitions of different classes of common drugs, Synthesis and uses of Aspirin, Paracetamol and Phenacetin.	**02**	PO1/ PO2/ PO3/ PO4/ PO5…
Total No. of Hours			**40**	

Learning Outcomes:	The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. The course will enable the student to: o **Define** the shielding effect, effective nuclear charge, dipole moment, oxidation-reduction, oxidation number, coordination number, hydrogen bonding, hybridization, reaction rate, molecularity, reaction order, internal energy, entropy, enthalpy, free energy, cell potentials, acids-bases, polymers, nylons, nanotechnology, nanoscale, and nanoparticles (**L1**). o **Illustrate** the periodic properties, Arrhenius equation, activation energy, solubility product, Nernst equation, biodegradable polymer, conducting polymer, vulcanization of rubber, nanomaterials, Fullerenes, Carbon nanotubes, Nano rods, nanowires, addition reaction, elimination reaction, substitution reaction, geometrical isomerism and optical isomerism (**L3**). o **Describe** the trends of periodic properties in the periodic table (**L2**). o **Calculate** the oxidation number and coordination number (**L4**). o **Determine** the hybridization, reaction rate, molecularity, reaction order, solubility product, activation energy, entropy and free energy (**L3**). o **Discuss** the factors affecting the periodic properties, consequences due to hydrogen bonding, factors affecting the reaction rate, theories of reaction rates, significance of entropy, applications of Nernst equation, characteristic properties of nanomaterials, electrophilic and nucleophilic addition, E1 and E2 elimination, S_N1 and S_N2 substitution (**L2**). o **Differentiate** between molecularity and reaction order, addition and condensation polymers, thermoplastics and thermosetting polymers, E1 and E2 elimination, S_N1 and S_N2 substitution, geometrical and optical isomerism (**L4**). o **Explain** the process of vulcanization, advantages of vulcanized rubber, applications of polymers, and nanomaterials (**L2**). o **Illustrate** the synthesis of PVC, PMMA, Teflon, Bakelite, Nylon 6, Nylon 6,6, Aspirin Paracetamol and Phenacetin (**L3**).

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1	B.H. Mahan, R.J. Myers, University Chemistry, 4th Edition, (Addison-Wesley) Thomson Press (India) LTD. (ISBN: 0-201-45576-5).	1998
2	P.W. Atkins, Physical Chemistry, Oxford University Press, New York (ISBN: 0-19-566902-9).	2005
3	B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, 44th Edition, Vishal Publishing Co., Jalandher, India (ISBN: 81-88646-74-1).	2009
4	P.C. Jain & M. Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company (P) LTD., New Delhi (ISBN: 978-93-5216-000-6).	2015
5	S.S. Dara, A Textbook of Engineering Chemistry, S. Chand & Company LTD., Ram Nagar, New Delhi (ISBN: 81-219-0539-9).	2002

6	Dr. Rajshree Khare, A textbook of Engineering Chemistry, S.K. Kataria & Sons, New Delhi, India.	2019
7	A Text Book of Engineering Chemistry, 16th Edition, by Jain & Jain - Dhanpat Rai & Sons, New Delhi, India.	2015
8	A Text Book of Engineering Chemistry by Dr. Rajshree Khare – S.K. Kataria & Sons, India.	2019

Course Code: BEM-C102
Course Name: ENGINEERING MATHEMATICS-I

MM: 100	**Sessional: 30**
Time: 3 Hr.	**ESE: 70**
L T P	**Credit : 4**
3 1 0	

Prerequisites:	*Fundamental of Calculus*
Objectives:	1. Introduction to differential calculus, Leibnitz theorem asymptotes, tracing of curves. 2. Introduction to partial differential calculus, Jacobians, Maxima, Minima and their application in engineering problems. 3. Introduction to double and triple integrals and its application to find area and volume, centre of gravity of plane and solids. 4. Introduction to vector calculus, curl, divergence and their application in engineering problems. 5. Introduction to matrices and their properties.
Course Coordinator	*Dr Vivek Goel*
Course Faculty	*Dr Vivek Goel*
Lectures	*40* Hours

NOTE:
The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Module	Course Content	No. of Hours	POS Mapped
Module-1	**Differential Calculus I:** Successive differentiation, Leibnitz theorem, Taylor's & Maclaurin's, Expansion, Indeterminate forms, Radius of curvature, Asymptotes, Double points and their classification, Tracing of curves.	*10*	*PO1/PO2/PO3/PO4/PO5/PO6/PO10/PO12*
Module-2	**Differential Calculus II :**Partial Differentiation of functions, Normal to surfaces and tangent	*8*	*PO1/PO2/ PO6/PO7/ PO12*

	plane, Change of variables, Jacobian, Taylor's series of two variables, Truncation errors, Extrema of function of two and more variables, Method of Lagrange's multipliers		
Module-3	**Multiple Integrals :**Fundamental Theorem of integral calculus, Differentiation under the integral sign, Double and triple integrals, Change of order of integration, change of variables. Application to arc length, area , volume, centroid and moment of inertia. Gamma and Beta functions, Dirichlet's integral.	*6*	*PO1/PO2/ PO3/PO6/ PO8/PO10 /PO12*
Module-4	**Vector Calculus :**Differentiation of a vector, Scalar and vector fields, Gradient, Divergence, Curl and their physical meanings, Differential operator and identities, Line, Surface and Volume integrals, Green's theorem in plane. Gauss and Stoke's theorems (without proof). Simple applications.	*6*	*PO1/PO2/ PO4/PO5/ PO6/PO7/ PO9/PO10 /PO12*
Module-5	**Matrices :**Elementary row/ column operations, Rank of a matrix and its applications, Eigen-values and Eign vectors, Cayley-Hamilton theorem, Diagonalisation of Matrices, Linear dependence and independence, Normal matrices, Complex matrices and unitary matrices	*10*	*PO1/PO2/ PO3/PO4/ PO5/PO6/ PO8/PO9/ PO10/PO1 2*
Total No. of Hours		*40*	

Learning Outcomes	1.Understand the concept of nth differentiation, Leibnitz theorems, 2.Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians. 3. To understand the concept of multiple integral and apply for finding area, volume, centre of mass and centre of gravity. 4. The concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals and its application. 5. Understand the concept of matrices and their applications to solve linear simultaneous equations. The concept of eigen value and eigen vector and complex matrices.

Suggested books: (*According to the reference style decided by departmental Board of Studies)*

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Prasad C., A first course in mathematics for Engineers, Prasad Mudranalaya	
2.	Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York,	1999
3.	Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi,	2000
4.	Srivastava R.S.L., Engineering Mathematics Vol.I	

BAC-C102/202
Engineering Chemistry
CO-PO/PSO MAPPING

CO-PO/PSO MAPPING

Course Outcomes (COs)	Action Verb (CO)	Bloom's Level	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
			Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management and Finance	Life Long Learning			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Define	Remember L1	3	3	2	2	3	3	2	2		3		3			
CO2	Illustrate	Apply L3	3	2	3	3	3	3	3	3		3	2	3			
CO3	Describe	Understand L2	3	3	3	3					3	3					
CO4	Calculate	Analyze L4	3	3	3	2					3	3					
CO5	Determine	Apply L3	3	3	3	3	3	3			3	3					
CO6	Discuss	Understand L2	3	3	3	3	2	3			3	3		3			
CO7	Differentiate	Analyze L4	3	3	3	3		3	3		3	3		3			
CO8	Explain	Understand L2	3	2	3	2	3	3	3		3	3	3	3			
CO9	Illustrate	Apply L3	3	2	2	2		3	3		3	3	3	3			
	Average		3	2.6	2.7	2.5	2.8	3	2.8	2.5	3	3	2.6	3			

Mapping %age		*0 - 5 = --*		*6 - 40 = 1*	*41 - 60 = 2*		*61 - 100 = 3*
Mapping Correlation		*No correlation*		*Low/ Slight*	*Moderate*		*Substantial/ High*

Mapping Correlation	***No correlation***	***Low/ Slight***	***Moderate***	***Substantial/ High***
	--	1	2	3

Course Code: BCE-C102/ BCE-C202
Course Name: PROGRAMMING FOR PROBLEM SOLVING

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	None
Objectives:	
Course Coordinator	Dr. Aman Tyagi

NOTE:	The question paper shall consist of two sections A, B. Section A contains 10 short type questions of 6 marks each, and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction to Computers:** Block diagram of computers, functions of its important components, Memory and I/O devices. Concept of assembler, interpreter, compiler & generation of languages. **Number System:** Decimal, Binary, Octal, and Hexadecimal numbers and their arithmetic (addition, subtraction, multiplication, and division): 1's and 2's complements	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	**Programming in C:** History, Introduction to C Programming Languages, Structure of C Programs, Compilation and Execution of C Programs, debugging techniques, Data Type and sizes, Declarations of variables, Modifiers, Identifiers and keywords, Symbolic Constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Pre-processor. **Operators:** Unary operators, Arithmetic & Logical operators, Bit wise operators, Assignment operators and expressions, Conditional expressions, Precedence and order of evaluation. **Control Statements:** If-else, switch, break, continue, the coma operator, go to statement. **Loops:** while, do-while, for loop.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	**Arrays:** One-dimensional arrays: declaration, initialization and application. Two-dimensional array: declaration, initialization and application, Multidimensional arrays. **Handling of Character Strings:** Declaring and initializing string variables, reading strings, Writing strings, Arithmetic operation on strings, comparison of two strings and string handling functions. **Pointers:** Accessing the address of the variable, Declaring and initializing pointers, accessing a variable through its pointer expression, pointer increment and scale factor, pointers and array, pointers and character strings.	**08**	PO1/ PO2/ PO3	PSO1 / PSO2

Module-4	**Functions:** Need for user defined function, return value and its type, function calls, no argument and No return values function, Argument and No return values functions, argument and return value functions. Handling of non-integer function, Scope and life time of variable in functions. **Recursion**: Recursive Definition and processes, recursion in C, example of recursion, Tower oh Hanoi Problem, simulating recursion, Backtracking, recursive algorithms, principles of recursion, tail recursion, removal of recursion.	**08**	PO1/ PO2/ PO3	PSO1 / PSO2
Module-5	**Structures:** Structures definition, giving value to members, structure initialization, array of structures, array within structures, structures within structures, structures and functions, Structure Pointers. **File Handling:** Creating and Deleting a File, Updating File, Copying File, Searching & Sorting in a File.	**08**	PO1/ PO2/ PO3	PSO1 /PSO 2
Total No. of Hours		**40**		

Course outcome	CO1: Knowledge and Understanding Demonstrate a foundational understanding of computer systems, including their block diagrams, major components, memory, and I/O devices, as well as different number systems and their arithmetic operations. CO2: Application of Concepts Apply the concepts of assembler, interpreter, and compiler to understand the generation of programming languages and their impact on software development. CO3: Analysis and Problem Solving Analyze and solve problems by writing and debugging C programs, including understanding data types, declarations, modifiers, and symbolic constants, and utilizing control statements such as if-else, loops, and arrays effectively. CO4: Critical Thinking and Algorithm Development Develop algorithms and implement them in C by demonstrating a deep understanding of operators, pointers, functions, and recursion, and by applying these concepts to problemsolving, including complex tasks such as simulating recursion and backtracking. CO5: Practical Application of Data Structures Apply data structure concepts, such as structures and file handling, to create, update, and manipulate data files, including searching and sorting, and understand their practical use in software development.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Rajaraman V.(3/e), Fundamental of Computers, PHI, New Delhi, 1999
2.	Sanders,D.H., Computers Today, Mcgraw Hill, 1998
3.	Kris Jamsa, DOS the complete reference, Tata McGraw Hill
4.	J.Peek Tim O'reilly & M.Locekides, UNIX POWER TOOLS, BPB Publication
5.	Yashwant Kanetkar, Let Us C, BPB
6.	Yashwant Kanetkar, C In Depth, BPB

Course Code: BME-C103
Course Name: BASIC MECHANICAL ENGINEERING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	None
Objectives:	
Course Coordinator	Mr. Praveen Pandey and Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections A, B. Section A contains 10 short type questions of 6 marks each, and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Unit	Course Content	No. of Hours	POs mapped	PSOs mapped
Unit-1	**Thermodynamics I**: Introduction to SI units, Definition of thermodynamic system, Surrounding and Universe, Quasi static process, Energy interaction Zeroth law, Concept of temperature First law of thermodynamics, Application to closed and open system, Concept of Enthalpy, steady flow energy equation, Throttling process.	**08**	PO1/ PO2/PO3	PSO1/ PSO2
Unit-2	**Thermodynamics II:** Second law, reversible and irreversible process, Thermal reservoir, heat engines and thermal efficiency, COP of heat pump and refrigerator, Carnot cycle, Claudius inequality, Concept of entropy, Entropy change for ideal gases.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Unit-3	**Thermodynamics III:** Generation of steam at constant pressure, Properties of steam, Use of property diagram, Process of vapor in closed and open system, Rankine cycle. Stroke clearance ratio, Compression ratio, Definition and calculation of mean effective pressure (no proof) for air standard cycles (Otto and diesel cycles	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Unit-4	**Mechanics: Trusses:** Plane structure, (Method of Joints and Sections only) Beams: Bending moment and shear force diagram for statically determinate beams.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Unit-5	**Strength of Materials:** Simple stresses and strain, strain energy, stress- strain diagram, elastic constants. Compound stress and strain: state of stress at a point, Simple tension, pure shear, general two-dimensional stress system, principal planes, principal stresses and strains, Mohr's stress circle, Poisson's ratio, maximum shear stress.	**08**	PO1/ PO2/ PO3	PSO1/PSO 2
Total No. of Hours		**40**		

Learning outcomes	After completing a course in Basic Mechanical Engineering, students should be able to understand fundamental principles, analyze mechanical systems, and apply knowledge to solve engineering problems, including understanding manufacturing processes and mechanical design.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Kumar DS (2/e), Thermal Science and Engineering, S.K.Kataria, New Delhi,2001
2.	P.K.Nag (2/e), Engineering Thermodynamics, TMH, New Delhi,2001
3.	R.Yadav(7/e), Thermal Engineering, Central Publishing House, Allahabad, 2000
4.	Shames Irving H.(4/e), Engineering Mechanics, PHI, New Delhi, 1994
5.	Hibler (1/e), Statics and Dynamics, Pearson Education, Singapore, 2000

Course Code: BEN-A103
Course Name: ENVIRONMENTAL STUDIES

MM: 100 **Time: 3 Hr.** **L T P** **2 0 0**	**Sessional: 30** **ESE: 70** **Credit: 0**

Prerequisites:	None
Objectives:	
Course Coordinator	

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**The Multidisciplinary Nature of Environmental Studies & Ecosystems:** (a) Definition, scope and importance of ecology and environment (b) The ecological components: (i) Abiotic components: soil, water, light, humidity and temperature (ii) Biotic components & their relationships- symbiosis, commensalisms, parasitism, predation and antibiosis (c) Concept of an ecosystem (d) Structure and function of an ecosystem (e) Producers, consumers and decomposers (f) Energy flow in the ecosystem (g) Ecological succession (h) Food chains, food webs and ecological pyramids (i) Introduction, types, characteristic features, structure and function of the following ecosystems: (i) Forest ecosystem (ii) Grassland ecosystem (iii) Desert ecosystem (iv) Aquatic ecosystems (pond, river, ocean estuaries, streams, lakes) (j) Need for public awareness	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	**Natural Resources:** (a) Renewable and Non-Renewable resources (b) Natural resources and associated problems: (i) Forest resources: use and over-exploitation, deforestation case, timber extraction, mining, dams and their effects on forest and tribal people (ii) Water resources: use and over-utilization of surface and ground floods, drought, conflicts over water, dams benefits and problem (iii) Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies (iv) Food resources : world food problems, changes caused by agriculture overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies (v) Energy resources:	**08**	PO1/ PO2/ PO3	PSO1/ PSO2

	growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies (vi) Land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification (vii) Biodiversity & its conservation: definition- genetic, species and ecosystem diversity, values of biodiversity- consumptive use, productive use, social, ethical, aesthetic and option values (viii) Biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity, threats to biodiversity- habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India, conservation of biodiversity: *in-situ* & *ex-situ* conservation of biodiversity (ix) Bio-geographical classification of India (x) Role of an individual in conservation of natural resources (xi) Equitable use of resources for sustainable lifestyles.			
Module-3	**Environmental Pollution:** (a) Definition, causes, effects and control measures of: air pollution, water pollution, soil pollution, noise pollution, thermal pollution and nuclear hazards (b) Solid waste management- causes, effects and control measures of urban and industrial wastes (c) Role of an individual in prevention of pollution (d) Pollution case studies (e) Disaster management: floods, earthquake, cyclone & landslides.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	**Social Issues and the Environment:** (a) From unsustainable to sustainable development (b) Urban problems related to energy (c) Water conservation, rain water conservation, rain water harvesting, management (d) Resettlement & rehabilitation of people- its problems and concerns, case studies (e) Environmental ethics- issues and possible solutions (f) Wasteland reclamation (g) Consumerism and waste products (h) Population growth, variation among nations, family welfare program (i) Environment and human health, human rights, value education (j) HIV/AIDS (k) Role of information technology (IT) in environment and human health (l) Case studies.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-5	**Environmental policies and laws:** Salient features of following acts (a) Environment Protection Act 1986 (b) Air (Prevention and Control of Pollution) Act 1981 (c) Water (Prevention and Control of Pollution) Act 1974 (d) Wildlife Protection Act 1972 (e) Forest Conservation Act 1980 (f) Issues involved in enforcement of environmental legislation (g) Public awareness.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Total No. of Hours		**40**		

Learning Outcomes:	

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Asthana, D. K. (2006). Text Book of Environmental Studies. S. Chand Publishing.
2.	Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India
3.	Basu, R. N., (Ed.) (2000). Environment. University of Calcutta, Kolkata

Course Code: BAC-C151/C251
Course Name: Engineering Chemistry Laboratory

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Pass : 40%**

Prerequisites:	**Engineering Chemistry Lab.**
Objectives:	The objective of the chemistry laboratory sessions is to: 1. Enable the students to get hands-on practice and to understand the applications of "qualitative and quantitative analysis" in engineering. 2. Develop the experimental skills by manual and by instrumentation. 3. Make students aware about the fundamental and experimental knowledge of chromatographic techniques like ascending paper chromatography and thin layer chromatography. 4. Learn the students to analyze the turbidity, pH, conductivity and refractive index instrumentally.
Course Coordinator	**Dr. Ajay Kumar**

NOTE:	In practical examination, the student shall be required to perform one experiment which carries 20 marks and 15 marks shall be reserved for practical record and viva-voce examination. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS

Choice of 10-12 experiments from the followings:

1. Chemical analysis of a salt (mixture of one acidic radical and one basic radical).
2. Determination of relative surface tension of given liquid by drop count method using stalagmometer.
3. Determination of relative viscosity of given liquid using Ostwald's viscometer.
4. Separation of given binary mixture by thin layer chromatography (TLC).
5. Separation of given binary mixture by ascending paper chromatography.
6. Determination of moisture content present in hydrated copper sulphate ($CuSO_4.5H_2O$).
7. Titration between a strong acid and strong base.
8. Titration between potassium permanganate and oxalic acid/Mohr's salt solution.
9. Determination of chloride content of given water sample by Mohr's method.
10. Determination of total hardness of a water sample by using standard EDTA solution.
11. Determination of turbidity of given sample using Nephelo turbidity meter.
12. Determination of conductance of different KCl solutions and calculation of the specific and equivalent conductance of each solution.
13. Determination of the pH of unknown solutions using a digital pH meter.
14. Determination of total dissolved solids (TDS) of given water samples.
15. Determination of refractive index of a liquid sample using the Abbe's refractometer.

16. Determination of molar mass of an unknown solid using the colligative property of freezing point depression.
17. Study of adsorption of acetic acid on charcoal and to verify Freundlich isotherm.
18. Preparation of a polymer (Polyvinyl chloride/Bakelite).

Learning Outcomes:	**Laboratory Outcomes** The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to: o **Analyze** a salt sample (**L4**). o **Measure** molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, pH, turbidity, refractive index, etc. (**L5**) o **Determine** the concentration of unknown sample via acid-base/redox titrations (**L3**). o **Separate** the components present in a mixture by TLC/Paper chromatography (**L4**). o **Estimate** the moisture content of a salt, chloride content, TDS and total hardness of water sample (**L4**). o **Prepare** a polymer (Polyvinyl chloride/Bakelite) (**L3**).

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1	Advanced Practical Physical Chemistry, by J.B. Yadav – Krishna Prakashan Media.	2016
2	Analytical Chemistry Vol. I, II, III, by Dr. Subhash Kumar Agarwala & Dr. Keemti Lal – Pragati Prakashan.	---
3	Applied Chemistry: Theory & Practice, Second Edition, by O.P. Virmani & A.K. Narula – New Age International Private Limited.	2017

BCE-C151/BCE-C251

PROGRAMMING FOR PROBLEM SOLVING LAB

MM :50 **Sessional: 15**
Time: 2 hrs. **ESE: 35**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS

1. Practice of all internal and external DOS commands.
2. Write simple batch program.
3. Giving exposure to windows environment.
4. File and program management in windows.
5. Practice of all UNIX commands.
6. Introduction to text editing and word processing.
7. Net surfing.
8. Creation and usage of E-mail account.
9. Write a program in C to perform different arithmetic operations.
10. Write a program in C to greater of two numbers.
11. Write a program in C to check whether no. is odd or even.
12. Write a program in C to check whether no. is prime or not.
13. Write a program in C to print Fibonacci series.
14. Write a program in C to print factorial of a no.
15. Write a program in C to add two matrices.
16. Write a program in C to search a no. in array.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Course Code: BME-C153/253

Course Name: Engineering Graphics and Design

MM: 100 **Time: 3 Hr.** **L T P** **1 0 2**	**Sessional: 15** **ESE: 35** **Credit : 2**

Prerequisites:	NIL
Objectives:	Nil

Course Coordinator	Dr. Sanjeev Lambha and Dr. Jasbir Singh
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit	Course Content	No. of Hours
Unit1	**Introduction to Engineering Drawing** Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering and dimensioning, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, and Hypocycloid Scales – Plain, Diagonal and Vernier Scales;	**8**
Unit-2	**Orthographic Projections and Projections of Regular solids** Principles of Orthographic Projections-Conventions – Principal planes, Auxiliary Planes, Introduction to first angle and third angle projection,Projections of Points, projection of lines-parallel to both the planes, parallel to one and inclined to other, inclined to both the planes, true length and traces of a line, and lines inclined to both planes, Projections of planes, traces of planes,angles of inclinations of planes, parallel planes	**8**

Unit-3	**Sections and Sectional Views of Right Angular Solids and Isometric Projections** Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right RegularSolids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views ofgeometrical solids, objects from industry and dwellings (foundation to slab only) Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	**8**
Unit-4	**Overview of Computer Graphics Customization and CAD Drawing** Computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software (AUTOCAD) [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in AUTOCAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.	**8**
Total		**40**

Learning Outcomes:	**Course Outcomes** All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address: • To prepare you to design a system, component, or process

	to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability • To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice • The student will learn: • Introduction to engineering design and its place in society • Exposure to the visual aspects of engineering design • Exposure to engineering graphics standards • Exposure to solid modelling and computer-aided geometric design • Exposure to creating working drawings and engineering communication

Suggested Books

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, CharotarPublishing House	2014
2.	Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, PearsonEducation	2002
3.	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication	2012
4.	Narayana, K.L. &Pannaiah (2008), Text book on Engineering Drawing, Scitech Publishers	2008

BEG-A251
TECHNICAL COMMUNICATION LAB

MM :50 **Sessional: 15**
Time: 2 hrs. **ESE: 35**
L T P **Credit: 1**
0 0 2

Experiments related to the following:
Objectives:
1. To expose the learners to English sound system and acquire phonetic skill and speech rhythm.
2. To help the learners use grammar correctly.
3. To train the learners to speak English, clearly, intelligibility and effectively.
4. To equip the learners to compete for a career, and enable them to function effectively in careers which demand good communication skills.

Contents:
i) Non - verbal communication
- Use of hands
- Posture of shoulders
- Eye contact
- Weight of the body
- Movement of the body

ii) Applied Phonetics
- Sound of English-consonants and Vowels
- Phonemic Transcription
- Stress, Rhythm and Intonation

Remedial Grammar
- Some useful expression (introduction, greetings etc.) that are used frequently.
- Common mistakes in the use of nouns, pronouns, adjectives, adverb, prepositions and conjunctions.
- Use of who and whome, much and many, still and yet, so as and so that, make and do.
- Tense and their use.
- Confusion of participles.
- Tag Questions

Reading and Speaking skills, Listening and Writing skills
- Presentation and addresses
- Group discussion
- Interviews
- Role playing

Reading and Writing skills, Listening and Writing skills

- Letter writing-formal and informal
- Real life social situations
- Curriculum vitae
- Agenda, notice and minutes

References

1). T. Balsubramaniam. “Phonetics for Indian students”, Macmillan India Ltd.
2). Jones, Daniel. “English Pronouncing Dictionary”, Cambridge Univ. Press.
3). Oxford Advanced Learners Dictionary.
4). Taylor, Grant. “Conversation Practice”, TMH, New Delhi.
5). F.T.A. Wood. “Remedial English Grammar”, Macmillan India Ltd.
6). Berry, Thomas Elliot. “The most common errors in English usage”, TMH, New Delhi.
7). N. Krishnaswamy. “Modern English”, Macmillan India Ltd.
8). Desmond. “People Watching”.

Course Outcomes

The student will acquire basic proficiency in English including reading and listeningcomprehension, writing and speaking skills.

Course Code: BAP-C202
Course Name: ENGINEERING PHYSICS

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit: 4**

Prerequisites:	None
Objectives:	
Course Coordinator	Dr. Devendra Singh

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Wave & Oscillations:** Simple harmonic motion, damped and forced simple harmonic oscillator, Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator – heavy, critical, and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	**Quantum Mechanics:** Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation & its solution for particle in box.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	**Electrostatics:** Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images with simple examples, energy of a charge distribution and its expression in terms of electric field.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	**Magnetostatics & LASERS:** Bio-Savart law, Divergence, and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities. Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby laser, He-Ne and CO2 laser, properties, and applications of lasers.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-5	**Electronic materials:** Free electron theory of metals, quantum	**08**	PO1/	PSO1/

	theory of free electrons, Fermi level, Density of states, Energy bands in solids, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Semiconductors: Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), concentration of charge carriers, Carrier generation and recombination, Carrier transport: diffusion and drift in p-n junction.		PO2/ PO3	PSO2
Total No. of Hours		**40**		

Learning Outcomes:	The concepts developed in this course will aid in quantification of several concepts in Physics that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. The course will enable the student to: • Define Free electrons theory of metals, quantum theory of free electrons, Fermi level, Density of states, Energy bands in solids, Direct and indirect band gaps, Types of electronic materials: metals, semiconductors and insulators, Occupation Probability, Fermi level. • (L1). • Illustrate Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier concentration and temperature (equilibrium carrier statistics), Concentration of charge carriers, Carrier generation and recombination, Carrier Transport: diffusion and drift in p-n junction (L3). • Describe the fundamentals of semiconductors (L2). • Calculate the mobility of charge carriers (L4). • Determine the radius of Bohr's first orbit of hydrogen atom by Heisenberg's uncertainty (L3). • Discuss the factors affecting the periodic properties, consequences due to hydrogen bonding, factors affecting the reaction rate, theories of reaction rates, significance of entropy, applications of Nernst equation, characteristic properties of nanomaterials, electrophilic and nucleophilic addition, E1 and E2 elimination, SN1 and SN2 substitution (L2). • Differentiate among conductors, insulators and semiconductors (L4). • Explain the process of population inversion in various types of lasers (L2). • Illustrate the pumping of various types used in lasing action (L3).

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	I.G. Main, Vibrations and Waves in Physics, Cambridge University Press (1993).
2.	H. J. Pain, The Physics of Vibrations and waves, Wiley India Pvt., Ltd. 6th Edition (2010).
3.	David Griffiths, Introduction to Electrodynamics, Pearson Education India Learning Private Ltd. 4th Edition (2015).
4.	Halliday, Resnick, Walker, Fundamental of Physics, Wiley India Pvt. Ltd; 10th Edition (2015).
5.	W. Saslow, Electricity, magnetism and light, Academic Press, 1th Edition (2002).
6.	E. Hecht, Optics, Pearson Education, India, 4 th Edition (2008).
7.	A. Ghatak, Optics, Tata McGraw-Hill Education India, 5 th Edition (2012).

8.	O. Svelto, Principles of Lasers, Springer Science & Business Media (2010).
9.	D.J. Griffiths, Quantum Mechanics, Pearson Education (2014).
10.	R. Robinett, Quantum Mechanics, OUP Oxford (2006).
11.	L.I. Schiff, Quantum Mechanics, Tata McGraw-Hill Education Pvt. Ltd, 4th Edition (2014)
12.	D.A. Neamen, Semiconductor Physics and Devices, Times Mirror High Education Group, Chicago (1997).
13.	E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore (1998).
14.	B. G. Streetman, Solid State Electronic Devices, Prentice Hall of India (1995).
15.	K. Charles, Introduction to Solid State Physics, John Wiley, Singapore, 7th Edition (1996).

Course Code: BEM-C202
Course Name: Engineering Mathematics II

MM: 100	**Sessional: 30**
Time: 3 Hr.	**ESE: 70**
L T P	**Credit: 4**
3 1 0	

Prerequisites:	This course provides an introduction to the basic concepts and techniques of
Objectives:	1. Ordinary differential equations and their types. Linear differential equations and their applications. 2. Partial differential equations and their solutions. 3. Introduction to series solution and special functions. 4. Introduction to Fourier series, Fourier series of special functions, half range series. 5. Introduction of Statistical tools, Binomial, Poisson and Normal distribution.
Course Coordinator	*Dr Vivek Goel*
Course Faculty	*Dr Vivek Goel*
Lectures	*40* Hours

NOTE:

		The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Course Handout cum Lecture Plan

Syllabus before Sessional 1(12 Lectures &3 Tutorials/ Practical's)			
Module	**Course Content**	**No. of Hours**	**POS Mapped**
Module-1	**Differential Equation:** Ordinary differential equations of first order, orthogonal trajectories, linear differential equations with constant coefficients, Euler- Cauchy equations, Equations of the form $y''= f(y)$. Solution of second order differential equations by change of dependent and independent variables, Method of variation of parameters for second order differential equations. Simple applications.	**8**	PO1/PO2/PO3/PO4/PO5/PO6/PO10/PO12
Module-2	**Partial Differential Equations and its Applications :** Introduction of partial	**9**	PO1/PO2/PO6/PO7/

	differential equations, Linear partial differential equations of II order with constant coefficients and their classifications parabolic, elliptic and hyperbolic with illustrative examples, Method		PO12

	of separation of variables. Wave and Heat equation up to two-dimensions.		
Module-3	**Solution in Series:** solution in series of second order linear differential equations, Bessel's and Legendre's equations and their solutions, Properties of Bessel function and Legendre's polynomials, Recurrence relations, Generating functions, Jacobi series, Integral representation of Bessel's functions.	**8**	*PO1/PO2/ PO3/PO6/ PO8/PO10 /PO12*
Module-4	**Fourier Series:** Fourier series, Dirichlet's condition and convergence. Half range series, Harmonic analysis.	**7**	*PO1/PO2/ PO4/PO5/ PO6/PO7/ PO9/PO10 /PO12*
Module5	**Statistics:** Moments, Moment generating functions. Binomial, Poisson and Normal distributions. Correlation and Regression. Method of least squares and curve fitting - straight line and parabola.	**8**	*PO1/PO2/ PO3/PO4/ PO5/PO6/ PO8/PO9/ PO10/PO1 2*
Total No. of Hours		**40**	

Course Outcomes	1. Understand the concept of differentiation and apply for solving differential equations. 2. Students understand the concepts of partial differential equations and how to solve linear Partial Differential with different methods and enable them to apply in solving problems like heat equation, wave equation etc.. 3. Get an idea of power series method to solve differential equations Familiar with Legendre equation and Legendre polynomial 4. To represent periodic functions using Fourier series. 5. Explore small and large data-sets to create testable hypotheses and identify appropriate statistical tests. Perform correlation, regression analysis and appropriate statistical tests for real life situations.

Suggested books: (*According to the reference style decided by departmental Board of Studies)*

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Prasad C., A first course in mathematics for Engineers, Prasad Mudranalaya	
2.	Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York,	1999
3.	Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi,	2000
4.	Srivastava R.S.L., Engineering Mathematics Vol.I	
5.	Kapur J. N. & Saxena H.C., Mathematical Statistics	1960

Course Code: BEE-C202
Course Name: BASIC ELECTRICAL ENGINEERING

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit: 4**

Prerequisites:	None
Objectives:	
Course Coordinator	Mr. Gaurav Kumar

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**D.C. Network Theory:** Concept of elements**,** Circuit theory concepts- Mesh and node analysis, Star-Delta transformation. Network Theorems- Super-position theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, DC Transients- RL, RC circuits.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	**Steady State Analysis of A.C. Circuits:** Sinusoidal and Phasor representation of voltage and current, average and rms value, form and peak factor of sinusoidal and different waveforms, single -phase A.C. circuit- behavior of resistance, inductance and capacitance and their combination in series & parallel and power factor, series parallel resonance-band width and quality factor. **Three Phase A.C. Circuits:** Star-Delta connections, line and phase voltage/current relations, three - phase power and its measurement.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	**Magnetic Circuits:** Ampere turns, magnetomotive force, permeability, reluctance, composite magnetic circuits, comparison between magnetic and electric circuits. **Transformer:** Principle of operation, types of construction, phasor diagram, equivalent circuit, efficiency and voltage regulation of single-phase transformer, O.C. and S.C. tests.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	**D. C. Machines:** Principle of electromechanical energy conversion, types of D.C. machines, E.M.F. equation, Magnetization and load characteristics, losses and efficiency, speed control of D.C. motors and applications. **Measuring Instruments:** Principle of working and constructional features of Permanent Magnet Moving Coil and	**08**	PO1/ PO2/ PO3	PSO1/ PSO2

	Moving Iron ammeters and voltmeters, Electrodynamic Wattmeter, Induction type single-phase Energy meter.			
Module-5	**Three-phase Induction Motor:** Principle of operation, types and methods of starting, slip-torque characteristics and applications. **Single-phase Induction Motor:** Principle of operation, methods of starting. **Three-phase Synchronous Machines**: Principle of operation and application of synchronous motor.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Total No. of Hours		**40**		

Learning Outcomes:	1. Define electrical networks mathematically 2. Develop elementary knowledge of electromagnetism 3. Compare DC and AC circuits and analyze them 4. Analyze elementary knowledge of Electric machines 5. Classify and compare different types of Electrical machines

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	V. Del Toro, Principles of Electrical Engineering, Prentice Hall International.
2.	H. Cotton, Advanced Electrical Technology, Wheeler Publishing.
3.	E. Huges, Electrical Technology.
4.	B. L., Theraja, Electrical Technology, Vol-1, S. Chand Publisher, New Delhi.
5.	W.H. Hayt & J.E. Kennedy, Engineering circuit Analysis, Mc Graw Hill.
6.	I.J. Nagrath, Basic Electrical Engineering, Tata Mc Graw Hill.
7.	A.E. Fitgerald, D.E., Higginbotham and A Grabel, Basic Electrical Engineering, Mc Graw Hill.
8.	Ashfaq Hussain, Fundamentals of Electrical Engineering, Dhanpat Rai Publish.

Course Code: BET-C202
Course Name: ELECTRONIC DEVICES

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit: 4**

Prerequisites:	None
Objectives:	
Course Coordinator	Mr.Prateek Agrawal and Mr.Amrish

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Semiconductors, energy band description of semiconductors, effect of temperature on semiconductors, intrinsic and extrinsic semiconductors, donor and acceptor impurities, electron and hole concentration, conductivity of a semiconductor, mobility and resistivity, Generation and Recombination, Hall effect, Fermi level, mass action law, charge densities in a semiconductor, diffusion and Poisson and continuity equation.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	P-N junction and its properties, V-I characteristics of P-N junction, semiconductor-diode, depletion layer, equivalent circuits of junction diode, diode equation, diode resistance and capacitance, application of junction diode as clippers, clampers and rectifiers (Half-wave, Full-wave and bridge), efficiency of rectifiers, ripple factor, filter circuits, Zener and avalanche breakdown mechanism, Zener diode and its characteristics, equivalent circuit of Zener diode, Zener diode as a voltage regulator, LED, photo diode and solar cell.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	Bipolar junction transistor (BJT) and its action, Transistor configurations (CB, CE and CC) and their characteristics, cut-off, active and saturation regions. Transistor as a switch, operating point, dc load line, Transistor biasing and its necessity, thermal runaway, types of biasing and their analysis, stability factors, Transistor as a regulator. Concept of Transistor amplifier, graphical analysis of CE amplifier, dc and ac equivalent circuits, Emitter follower and its ac model.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	Ebers-Moll model of BJT, T model of BJT, Hybrid model of BJT at low frequency, computation of voltage gain, current gain and power gain, Zi and Zo and approximate formulas, high frequency transistor hybrid π model.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2

Module-5	Field Effect Transistor: JFET and its characteristics, biasing of JFET, small signal low frequency and high frequency model of JFET amplifier, configurations of JFET, MOSFET, MESFET (Enhancement & depletion types) their construction and characteristics, configuration of MOSFET, MOS capacitor.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Total No. of Hours		**40**		

Learning Outcomes:	At the end of the course the students can able to • Analyze the characteristics of different electronic devices such as diodes, transistors etc • Measure voltage, frequency and phase of any waveform using CRO. • Create sine, square and triangular waveforms with required frequency and amplitude using function generator.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Integrated Electronics: Jacob Millman & C.C. Halkias
2.	Malvino and leach “Digital principle and applications.
3.	Streetman Ben.G, “Solid state electronic devices” (3/e), PHI
4.	Millman and grabel, “Microelectronics” PHI
5.	Robert Bolyestad “Electronic devices and circuit”, PHI

Course Code: BHU-S202
Course Name: VEDIC SCIENCE & ENGINEERING

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit: 0**

Prerequisites:	None
Objectives:	
Course Coordinator	Dr. Murali Manohar Tiwari

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Science in Vedic literature and Indian Philosophy-I**: Kanad's atomic theory, concept of parmanu, Formation of molecules, Parimandal, Comparison with Dalton's atomic theory and models of Thompson, Rutherford and Bhor. Concept of SAMATA and VISHAMTA vs Maxwell-Boltzmann's distribution of velocities and energies.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	**Science in Vedic literature and Indian Philosophy-II**: First and Second Law of thermodynamics in daily life. Law of helplessness of mankind in thermodynamics and Indian philosophy. Entopy in life and concept of pralaya. Dhananjay Vs concept of Radioactivity-life after death. Atomic spectrum Vs concept of Kundalini.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	**Vedic Mathematics**: Measurements in Vedic Times, ancient scale of length, mass, time and temperature, Number system, Geometry according to sulba Sutra. Overview of Vedic Mathematical Rules (ekadhiken pooren, Nikhil navtascharaman dashatah, oordhavatriyagyabhyam)	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	**Electrical, Electronics & Aeronautical Engineering in Vedas**: Concept of electrical Engineering, type of electricity – Tadit, Saudamini, Vidyut, Shatakoti, Haradini, Ashani. Electronics Engineering in Vedic literature. Aeronautical Engineering in Vedic literature, Types of Vimanas and their construction and working, Shakun viman, Rukma viman, Tripura viman, concept of calculator and ancient ways of computation.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2

Module-5	**Mechanical, Chemical, Civil & Architectural engineering in Vedic Literature**: Mechanical & Chemical Engineering in ancient India, Art of Alchemy, Types of Iron and steel. Civil and Architectural engineering in Vedic literature. Concept of cryptography & Art of secret writing.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Total No. of Hours		**40**		

Learning Outcomes:	B.Tech. students of all programmes of faculty of engineering & technology will be able to learn about the development of various concepts of sciences and engineering in ancient India.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Science in Vedas by Acharya Vaidyanath Sashtri.
2.	Science in the Vedas by Hansraj, Shakti Publications, Ludhiana.
3.	Vedic Mathematics by Swamisri Bharati Krishana Teerathaji, Motilal Banarasi Das, Delhi.
4.	Brahad Viman shastra by Maharishi Bhardwaj.
5.	Vymanika shastra, English translation by G. R. Josyer.
6.	Alchemy and Metallic Medicines in Ayurveda by : Vaidya Bhagwan Das.
7.	History of Hindu Chemistry by : P. C. Raya
8.	Indian Alchemy by : Dr. S. Mahdihassan.
9.	Ancient Scientist of Indian by Satya Prakash.
10.	Vaishaishik Darshan by Maharishi Kanad.
11.	Vedas : The sources of ultimate science by S. R. Verma, Nag Publisher, New Delhi.

Course Code: BAP-C151/BAP-C251
Course Name: Engineering Physics Laboratory

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	**Engineering Physics Lab.**
Objectives:	The objective of the Physics laboratory sessions is to: 1. Enable the students to get hands-on practice and to understand the applications of Physics in engineering. 2. Develop the experimental skills by manual and by instrumentation. 3. Make students aware about the fundamental and experimental knowledge of Physics.
Course Coordinators	**Dr. Sunil Panwar& Dr. Devendra Singh**

NOTE:	In practical examination, the student shall be required to perform one experiment which carries 20 marks and 15 marks shall be reserved for practical record and viva-voce examination. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students.Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS

There are only ten experiments which are given below:

1. To verify the inverse square law of radiation using photoelectric effect.
   To determine the value of Planck's constant and photoelectric work function of the material of the cathode using photoelectric cell.
2. To determine the frequency of an unknown signal by drawing the Lissajous patterns for various frequency ratios and evaluate the phase difference between two sinusoidal signals applied to X and Y inputs of cathode ray oscilloscope.
3. To determine the value of e/m of an electron by Helical Method/ Magnetron Method.
4. To determine the resistivity and energy band gap by four probe method.
5. To find the refractive index of the material of given prism by using spectrometer.
6. To determine the wavelength of He-Ne laser by diffraction method.
7. To determine the Stefan's constant.

8.	To determine the radius of circular coil by variation of magnetic field
9.	To determine the spring constant by Hook's law.

Learning Outcomes:	**Laboratory Outcomes** The Physics laboratory course will consist of experiments illustrating the principles of Physics relevant to the study of science and engineering. The students will learn to: o **Analyze** Semiconductor sample by Four Probe Method. o **Measure** the Specific charge of electron. o **Analyse** the drawing of Lissajous Patterns. o **Determination** of the refractive index of Prism's material by Spectrometer. o **Estimate** the resistivity of the semiconductor.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1	Manual for electrical measurement lab, Dr. Devendra Singh & Dr. Rajeev Saxena, National Press Associates, New Delhi	2017
2	Practical Physics, Dr. GK Gupta, Dr. VK Goel, M.S.Tomar, KedharnathRamnath, Meerut Delhi	--
3	Practical Physics, CL Arora, S Chand Publication	2014

BAP-C151/BAP-C251
Engineering Physics Lab.
CO-PO/PSO MAPPING

CO-PO/PSO MAPPING

Course Outcomes (COs)	Action Verb (CO)	Bloom's Level	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
			Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management and Finance	Life Long Learning			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze	Analyze L4	3	3	3	3	2	3	3	2		3	3	3			

CO2	**Measure**	**Evaluate L5**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**		**3**	**2**	**3**			
CO3	**Determine**	**Apply L3**	**3**	**3**	**3**	**2**	**2**	**3**			**3**	**3**	**3**	**2**			
CO4	**Separate**	**Analyze L4**	**3**	**3**	**3**	**3**	**2**	**3**			**3**	**3**	**2**	**2**			
CO5	**Estimate**	**Analyze L4**	**3**	3	3	3	3	3	3	3	3	3	3	**3**			
CO6	**Prepare**	**Apply L3**	**3**	3	2	3		3	3		3	3	3	**3**			
	Average		**3**	**3**	**2.8**	**2.6**	**2.4**	**3**	**3**	**2.6**	**3**	**3**	**2.6**	**2,6**			

Course Code: BEE-C 151/BEE-C251
Course Name: BASIC ELECTRICAL ENGINEERING LAB

MM: 100 **Time: 3 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	Physics and Mathematics at 10+2 level
Objectives:	1. This course deals with basic introduction of system components of electrical systems, and provides hands on practice in assembling, interconnecting, testing, and repairing such system by making use of various tools used in electrical workshop.
Course Coordinator	Mr. Gaurav Kumar, Asst. professor

Experiments	**Lab Content**	**No. of Hours**	**POs mapped**	**PSOs mapped**
Exp. No. 1	Verification of Kirchoff's laws.	02	PO1/ PO2 PO3/PO4	PSO 1/PSO 2/ PSO 3
Exp. No. 2	Verification of Thevenin's theorems.	02	PO1/ PO2 PO3/ PO4	PSO 1/ PSO 2/ PSO 3
Exp. No. 3	Verification of Norton's theorem	02	PO1/ PO2 PO3/ PO4	PSO 1/ PSO 2/ PSO 3
Exp. No. 4	Verification of Superposition theorem.	02	PO1/ PO2 PO3/ PO4	PSO 1/ PSO 2/ PSO 3
Exp. No. 5	Verification of maximum power transfer theorem.	02	PO1/ PO2 PO3/ PO4	PSO 1/ PSO 2/ PSO 3
Exp. No. 6	Measurement of power in three-phase circuit by two wattmeter method.	02	PO3/ PO1	PSO 1/ PSO 2/ PSO 3
Exp. No. 7	Determination of efficiency of a single-phase transformer by load test.	02	PO1/ PO3	PSO 1/ PSO 2/ PSO 3
Exp. No. 8	To perform open circuit test on single-phase transformer & find equivalent circuit parameters.	02	PO1/ PO3	PSO 1/ PSO 2/ PSO 3
Exp. No. 9	To perform short circuit test on single-phase transformer & find equivalent circuit parameters	02	PO3/ PO4/ PO1/ PO2	PSO 1/ PSO 2/ PSO 3
Exp. No. 10	D.C. generator characteristics (a) Shunt generator (b) Series generator (c) Compound generator	02	PO3/ PO4	PSO 1/ PSO 2/ PSO 3
Exp. No. 11	Speed control of D.C. shunt generator.	02	PO3/ PO4/ PO1/ PO2	PSO 1/ PSO 2/ PSO 3
Exp. No. 12	To study running and reversing of a three-phase Induction Motor	02	PO3/ PO4	PSO 1/ PSO 2/ PSO 3

Exp. No. 13	To study & calibration of a single-phase Energy Meter.	02	PO3/ PO1/	PSO 1/ PSO 2/ PSO 3
Exp. No. 14	Calibration of voltmeter and ammeter..	02	PO2/ PO1/ PO3/ PO4	PSO 1/ PSO 2/ PSO 3
Exp. No. 15	To study of resonance in RLC circuit.	02	PO3/ PO1	PSO 1/ PSO 2/ PSO 3

Course Outcomes:	1. Illustrate the application of KVL/KCL and network theorems to DC electrical circuits. 2. Select the appropriate tools and components required for specific operation. 3. Demonstrate the behavior of a single-phase AC series resonant circuit. 4. Calculate efficiency of a single-phase transformer and DC machine. 5. Calculate efficiency of a single-phase transformer and DC machine.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	3	1		2		3	1	3	1	2	3	3
CO2	3	3	3	3		1		1		3		3	2	3	3
CO3	3	3	3	3	1		2		2	2	1		2	3	3
CO4	3	3	3	3	1	2				2	1		2	3	3
CO4	3	3	3	2	2	1	3		1	2	1	2	2	3	2

Course Name: ELECTRONIC DEVICES LAB
Course Code: BET-C151/BET-C251

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional:15** **ESE:35** **Credit:1**

Prerequisites:	None
Objectives:	• To study basic electronic components • To observe characteristics of electronic devices
Course Coordinator	Mr. Prateek Agarwal

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 30 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 30 students. 4.The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D.

LIST OF EXPERIMENTS	1. To draw the V-I characteristics of PN junction diode. 2. To draw the V-I characteristics of Zener diode and study it as voltage regulator. 3. To study junction diode as half wave and full wave rectifier. 4. To study junction diode as clipper and clamper. 5. To draw the input and output characteristics of a transistor in CE and CB configuration. 6. To find the small signal h-parameters of a transistor. 7. To draw the input and output characteristics of FET and to measure the pinch off voltage. 8. To draw the drain and transfer characteristic curve of MOSFET. 9. To draw the frequency response of FET amplifier. 10. To draw the frequency response curve of Emitter Follower.

Learning Outcomes:	At the end of the course the students can able to • Analyze the characteristics of different electronic devices such as diodes, transistors etc • Measure voltage, frequency and phase of any waveform using CRO. • Create sine, square and triangular waveforms with required frequency and amplitude using function generator.

Effective from the session 2024-25

Course Code: BAP-C151/BAP-C251
Course Name: Engineering Physics Laboratory

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	**Engineering Physics Lab.**
Objectives:	The objective of the Physics laboratory sessions is to: 4. Enable the students to get hands-on practice and to understand the applications of Physics in engineering. 5. Develop the experimental skills by manual and by instrumentation. 6. Make students aware about the fundamental and experimental knowledge of Physics.
Course Coordinators	**Dr. Sunil Panwar& Dr. Devendra Singh**

NOTE:	In practical examination, the student shall be required to perform one experiment which carries 20 marks and 15 marks shall be reserved for practical record and viva-voce examination. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students.Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS

There are only ten experiments which are given below:

1.To verify the inverse square law of radiation using photoelectric effect.
2.To determine the value of Planck's constant and photoelectric work functionof the material of the cathode using photoelectric cell.
3.To determine the frequency of an unknown signal by drawing the Lissajous patterns for various frequency ratios and evaluate the phase difference between two sinusoidal signals applied to X and Y inputs of cathode ray oscilloscope.
4.To determine the value of e/m of an electron by Helical Method/Magnetron Method.
5.To determine the resistivity and energy band gap by four probemethod.
6.To find the refractive index of the material of given prism by usingspectrometer.
7.To determine the wavelength of He-Ne laser by diffraction method.
8.To determine the Stefan's constant.
9.To determine the radius of circular coil by variation of magnetic field.
10. To determine the spring constant by Hooks law.

Learning Outcomes:	**Laboratory Outcomes** The Physics laboratory course will consist of experiments illustrating the principles of Physics relevant to the study of science and engineering. The students will learn to: o **Analyze** Semiconductor sample by Four Probe Method. o **Measure** the Specific charge of electron. o **Analyse** the drawing of Lissajous Patterns. o **Determination** of the refractive index of Prism's material by Spectrometer. o **Estimate** the resistivity of the semiconductor.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1	Manual for electrical measurement lab, Dr. Devendra Singh & Dr. Rajeev Saxena, National Press Associates, New Delhi	2017
2	Practical Physics, Dr. GK Gupta, Dr. VK Goel, M.S.Tomar, KedharnathRamnath, Meerut Delhi	--
3	Practical Physics, CL Arora, S Chand Publication	2014

BAP-C151/BAP-C251
Engineering Physics Lab.
CO-PO/PSO MAPPING

CO-PO/PSO MAPPING

Course Outcomes (COs)	Action Verb (CO)	Bloom's Level	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
			Engineering Knowledge	Problem Analysis	Design/ Development of Solutions	Conduct Investigations of Complex Problems	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Indidual and Team Work	Communication	Project Management and Finance	Life Long Learning			
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze	Analyze L4	3	3	3	3	2	3	3	2		3	3	3			

CO2	**Measure**	**Evaluate L5**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**		**3**	**2**	**3**			
CO3	**Determine**	**Apply L3**	**3**	**3**	**3**	**2**	**2**	**3**			**3**	**3**	**3**	**2**			
CO4	**Separate**	**Analyze L4**	**3**	**3**	**3**	**3**	**2**	**3**			**3**	**3**	**2**	**2**			
CO5	**Estimate**	**Analyze L4**	**3**	3	3	3	3	3	3	3	3	3	3	**3**			
CO6	**Prepare**	**Apply L3**	**3**	3	2	3		3	3		3	3	3	**3**			
	Average		**3**	**3**	**2.8**	**2.6**	**2.4**	**3**	**3**	**2.6**	**3**	**3**	**2.6**	**2,6**			

Course Code: BME-C252

Course Name: Workshop Practice Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Prerequisites:	NIL
Objectives:	
Course Coordinator	Mr. Rishi Kumar and Mr. Kapil Dev Sharma

Module	Course Content	No. of Hours
Module-1	Carpentry Shop 1. Study of Carpentry Tools, Equipment and different joints. 2. To prepare a half T joint of given dimensions.	**04**
Module-2	Moulding Shop 3. Introduction to Patterns, pattern allowances, Gate, Riser, and Runner. 4. To prepare a mould of half bearing.	**04**
Module-3	Metal Joining. 5. To prepare a butt joint of MS strips using Arc welding. 6. To prepare a T joint of MS strips using Oxy Acetylene gas welding.	**04**
Module-4	Fitting Shop 7. To prepare a rectangular piece with slant edge of given size from M.S. flat.	**02**
Module-5	8. To prepare a job on Lathe machine of given shape and size. 9. To prepare a job on Shaper machine of given shape and size. 10. To prepare a job on Milling machine of given shape and size. 11. To prepare a job on CNC train master of given shape and size. 12. To prepare a job on drilling machine of given shape and size.	**10**
Total No. of Hours		**24**

Learning Outcome	
	• Build thorough knowledge of various tools, machines, devices used in engineering • Acquire thorough knowledge of carrying out various operations in mechanical engineering workshop • Utilize measuring skills gained in workshop practice. • Acquire “Hands on” training and practice to students for use of various tools, devices and machines. • Utilize practical skills in guiding works the trades.

NOTE 1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

Course Code: BSP-S251
Course Name: PHYSICAL TRAINING & YOGA

MM: 50 **Time: 3 Hr.** **L T P** **0 0 2**	**Sessional: 50** **ESE: 0** **Credit : 0**

Prerequisites:	None
Objectives:	• To make the students understand the importance of sound health and fitness principles as they relate to better health. • To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness. • To create a safe, progressive, methodical and efficient activity-based plan to enhance improvement and minimize risk of injury. • To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.
Course Coordinator	**Dr. Dharmendra Balyan**

NOTE:	The question paper shall consist of two sections A, B. Section A contains 10 short type questions of 6 marks each, and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction to Physical Education** o Meaning & definition of Physical Education o Aims & Objectives of Physical Education o Changing trends in Physical Education	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	**Olympic Movement** o Ancient & Modern Olympics (Summer & Winter) o Olympic Symbols, Ideals, Objectives & Values o Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	**Physical Fitness, Wellness & Lifestyle** o Meaning & Importance of Physical Fitness & Wellness o Components of Physical fitness o Components of Health related fitness o Components of wellness o Preventing Health Threats through Lifestyle Change o Concept of Positive Lifestyle	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	**Fundamentals of Anatomy & Physiology in Physical Education, Sports and Y oga** o Define Anatomy, Physiology & Its Importance o Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-5	**Kinesiology, Biomechanics & Sports** o Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports o Newton's Law of Motion & its application in sports. o Friction and its effects in Sports.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-6	**Postures** o Meaning and Concept of Postures. o Causes of Bad Posture. o Advantages & disadvantages of weight training. o Concept & advantages of Correct Posture.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2

	o Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis. o Corrective Measures for Postural Deformities			
Module-7	**Yoga** o Meaning & Importance of Yoga o Elements of Yoga o Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas o Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana) o Relaxation Techniques for improving concentration - Yog-nidra	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-8	**Yoga & Lifestyle** o Asanas as preventive measures. o Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana. o Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana. o Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana. o Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana. o Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-9	**Training and Planning in Sports** o Meaning of Training o Warming up and limbering down o Skill, Technique & Style o Meaning and Objectives of Planning. o Tournament – Knock-Out, League/Round Robin & Combination.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-10	**Psychology & Sports** o Definition & Importance of Psychology in Physical Edu. & Sports o Define & Differentiate Between Growth & Development o Adolescent Problems & Their Management o Emotion: Concept, Type & Controlling of emotions o Meaning, Concept & Types of Aggressions in Sports. o Psychological benefits of exercise. o Anxiety & Fear and its effects on Sports Performance. o Motivation, its type & techniques. o Understanding Stress & Coping Strategies.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-11	**Doping** o Meaning and Concept of Doping o Prohibited Substances & Methods o Side Effects of Prohibited Substances	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-12	**Sports Medicine** o First Aid – Definition, Aims & Objectives. o Sports injuries: Classification, Causes & Prevention. o Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries	**08**	PO1/ PO2/ PO3	PSO1/ PSO2
Module-13	**Sports / Games** Following subtopics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2

	o History of the Game/Sport. o Latest General Rules of the Game/Sport. o Specifications of Play Fields and Related Sports Equipment. o Important Tournaments and Venues. o Sports Personalities. o Proper Sports Gear and its Importance.			
Total No. of Hours		**40**		

Learning Outcomes:	1. To practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation. 2. To learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance. 3. To learn breathing exercises and healthy fitness activities 4. To understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination. 5. To perform yoga movements in various combination and forms. 6. To assess current personal fitness levels. 7. To identify opportModuleies for participation in yoga and sports activities. 8. To develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc. 9. To improve personal fitness through participation in sports and yogic activities. 10. To develop understanding of psychological problems associated with the age and lifestyle. 11. To demonstrate an understanding of sound nutritional practices as related to health and physical performance. 12. To assess yoga activities in terms of fitness value. 13. To identify and apply injury prevention principles related to yoga and physical fitness activities. 14. To understand and correctly apply biomechanical and physiological principles elated to exercise and training.

S. No.	Name of Authors /Books /Publisher/Year
1.	Modern Trends and Physical Education by Prof. Ajmer Singh.
2.	Light On Yoga by B.K.S. Iyengar.
3.	Health and Physical Education – NCERT (11th and 12th Classes)

Course Code: BEM-C302
Course Name: Engineering Mathematics III

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	NIL
Objectives:	Nil

Course Coordinator	Dr. Lokesh Joshi
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit	MODULE	Course Content	No. of Hours
Unit 1	Module-1	Laplace Transform: Laplace transform of elementary functions, shifting theorems, transform of derivatives, Differentiation and Integration of transforms, Heaviside unit step and Dirac Delta functions, Convolution theorem, Solution of ordinary linear differential equations used in Mechanics, Electric circuits and bending of beams.	8
Unit -2	Module-2	Fourier Transform:Definitionof Fourier transform, Fourier sine and cosine transforms. Fourier integral formula, Parseval's identity, Applications of Fourier transform in solving heat equations.	8
Unit -3	Module-3	Z transform: Definition, Linearity property, Z transform of elementary functions, Shifting theorems, Initial and final value theorem, Convolution theorem, Inversion of Z transforms, Solution of difference equations by Z transforms.	8

Unit -4	Module -4	Functions of Complex Variable: Limit and Continuity of functions of Complex Variables: Analytic Functions, Harmonic Conjugate, Cauchy-Riemann Equations (without proof), Line Integral, Cauchy Goursat theorem (without proof), Cauchy Integral formula (without proof), Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for Evaluation of Real Integral (Unit Circle).	8
Unit -5	Module -5	Errors and Roots of Equations: Absolute, relative, round-off and truncation errors. Significant digits. Algebraic and Transcendental Equations, Numerical solution, Method of bisection, Newton-Raphson method, Direct iterative method, convergence.	8
Total			40

Learning Outcomes:	

Text Books / References

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York, 1999
2. Gerald, C.F., Wheatley P.O., Applied Numerical Analysis, Pearson, 2007.
3. Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi, 2000.
4. Jain R. K., Iyenger S.R.K., Advanced Engineering Mathematics, Narosa , 2002.
5. Jain R. K., Iyenger S.R.K., Jain M.K., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 2012.

Course Code: BME-C306

Course Name: Material Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	NIL
Objectives:	Nil

Course Coordinator	Dr. Sunil Sharma
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit	Module	Course Content	No. of Hours
Unit1	**Module-1**	Crystal Structure: Crystal structure determination technique, Miller Indices, Diffusion, Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems.	**8**
Unit-2	**Module-2**	Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.	**8**
Unit-3	**Module-3**	Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Fick law, Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).	**8**
Unit-4	**Module-4**	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid andmonotectic reactions. Iron Iron-carbide phase diagram	**8**

		and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.	
Unit-5	**Module-5**	Heat treatment of Steel: Annealing, tempering, normalising and spheroid sing, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.	**8**
Total			**40**
		Total No. of Hours	**40**

Learning Outcomes:	Analyse the Structure of materials at different levels, basic concepts of crystalline materials like unit cell. Understand concept of Mechanical Property of materials and testing. Explain different failure theory and testing. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Understand the heat treatment process and hardening process.

Suggested Books

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	Higdon, A., Ohlsen, E.H., Stiles, W.B., Weese, J.A., and Riley, W.F., "Mechanics of Materials", John Wiley & Sons, ISBN: 978-0-470-50873-2.	1989
2.	Timoshenko, S.P., and Gere, J.M., "Mechanics of Materials", 2nd Ed., CBS Publishers, ISBN: 9788123908946.	2002
3.	W. D. Callister, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India, **ISBN-10:** 0471736961	2006
4.	Hearn, E.J., "Mechanics of Materials", 3rd Ed., Pergamon, **SBN:** 9780750632669.	2003

Course Code: BME-C308
Course Name: Engineering Mechanics

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	NIL
Objectives:	Nil

Course Coordinator	Mr. Kapil Dev Sharma
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit	Module	Course Content	No. of Hours
Unit1	Module-1	Systems Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in pace – Rigid Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Resultant-Moment of Forces and its Application; Couples and Resultant of Force System; Static Indeterminacy.	**8**
Unit-2	Module-2	Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.	**8**
Unit-3	Module-3	Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines. .	**8**
Unit-4	Module-4	Centroid of simple figures from first principle. centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles Theorems of moment of inertia, Moment of inertia of standard sections and composite	**8**

		sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.	
Unit-5	Module-5	Introduction to Kinetics of Rigid Bodies, Types of motion, Instantaneous center of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;	**8**
Total			**40**

Learning Outcomes:	**Define** Free body diagrams, Limiting friction, Static and Dynamic Friction, Simple Trusses, Centre of Gravity. **How** to determine if a member is in tension or compression using method of Section and method of Joint **Explain** System of Forces, types of beams, types of structure, Equations of Equilibrium of Coplanar Systems. **Apply** the concepts of Equations of Equilibrium on a force system, Laws of friction on a forced system.

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Irving H. Shames, Engineering Mechanics, 4th Edition, Prentice Hall, ISBN: 0133569241	2006
2.	P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, ISBN: 9781260085006	2011
3.	Bansal R.K., A Text Book of Engineering Mechanics, Laxmi Publications, ISBN-10: 8131804097.	2010
4.	Khurmi R.S., Engineering Mechanics, S. Chand & Co., ISBN-10: 8121931002.	2010
5.	Tayal A.K., Engineering Mechanics, Umesh Publications,5SBN 9789380117386.	2010

Course Code: BME-C309
Course Name: Fluid Mechanics

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	NILL
Objectives:	• To understand the properties of fluids and fluid statics • To derive the equation of conservation of mass and its application • To solve kinematic problems such as finding particle paths and stream lines • To use important concepts of continuity equation, Bernoulli's equation and turbulence, and apply the same to problems .

Course Coordinator	Yogesh Kumar

Unit	Module	Course Content	No. of Hours
Unit-1	*Module-1*	Introduction**:** Fluids and continuum; Physical properties of fluids: Viscosity, Compressibility, Surface Tension, Capillarity, Vapour Pressure; Cavitation; Classification of fluids including rheological classification	**4**
	Module-2	Pascal's law; Pressure-density-height relationship; Measurement of pressure by Manometers and mechanical gauges; Pressure on plane and curved surfaces; The Hydrostatic law; Total Pressure and Centre of pressure;	**4**
Unit-2	*Module-3*	Buoyancy; Stability of immersed and floating bodies; Fluid masses subjected to uniform horizontal and vertical accelerations	**2**
	Module-4	Description of Fluid flow: Lagrangian and Eulerian approach; Types of fluid Flows: Steady and unsteady, Uniform and non-uniform, Laminar and turbulent flows, 1, 2 and 3-D flows; Stream lines, Path lines and Streak lines	**4**
Unit-3	*Module-5*	Differential and Integral form of Continuity equation; Rotation, Vorticity and Circulation; Elementary explanation of Stream function and Velocity potential	**4**
	Module-6	Fluid Dynamics-I: Concept of control volume and control surface, Reynolds Transport Theorem, Introduction to Navier-Stokes Equations, Euler's equation of motion along a streamline and its integration, Bernoulli's equation and its applications – Pitot tube, Flow through orifices, Mouthpieces, Nozzles, Free and Forced vortex motion.	**4**
Unit-4	*Module-7*	Fluid Dynamics-II**:** Impulse-Momentum Principle; Moment of momentum equation; flow measurements, Venturimeter,	**4**

		Orificemeter, determination of coefficients of discharge, velocity and contraction and energy loss. Laminar Flow: Reynolds Experiment; Equation of motion for laminar flow through pipes; Flow between parallel plates; Kinetic energy and Momentum correction factors; Stokes law; Flow through porous media; Measurement of viscosity; Transition from laminar to turbulent flow.	
Unit-5	*Module-8*	Boundary Layer Analysis**:** Boundary layer thicknesses; Boundary layer over a flat plate; Laminar boundary layer; Application of Von-Karman Integral Momentum Equation; Turbulent boundary layer; Laminar sub layer; Hydro-dynamically Smooth and rough boundaries; Local and average friction coefficient; Total drag; Boundary layer separation and its control.	**4**
	Module-9	Flow Through Pipes**:** Nature of turbulent flow in pipes; Equation for velocity distribution over smooth and rough surfaces; Major and Minor energy losses; Darcy's Law; Resistance coefficient and its variation; Hydraulic gradient and total energy lines. Flow in sudden expansion, contraction,diffusers, bends, valves and siphons; Concept of equivalent length; Branched pipes; Pipes in series and parallel; Simple pipe networks.	**6**
	Module-10	Flow Past Submerged Bodies**:** Drag and lift, Types of drag force, Drag on sphere, Cylinder and airfoil; Magnus effect.	**4**
	Total No. of Hours		**40**

Learning Outcomes:	• Understand the various properties of fluids and their influence on fluid motion and analyse a variety of problems in fluid statics and dynamics. • Calculate the forces that act on submerged planes and curves. • Identify and analyse various types of fluid flows. • • Apply the integral forms of the three fundamental laws of fluid mechanics to turbulent and laminar flow through pipes and ducts in order to predict relevant pressures, velocities and forces. • Draw simple hydraulic and energy gradient lines.

S.No.	Book/Author/ Publication	Year of Publication
1.	R K Bansal: Fluid Mechanics and Hydraulic Machines, laxmi publication	2000
2.	Modi and Seth: Fluid Mechanics and Fluid Machines	2002
3	V Gupta and S K Gupta, Fluid Mechanics and its Applications, Wiley eastern ltd.	2001

Course Code: BME-C356

Course Name: Material Engineering Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Prerequisites:	NIL
Objectives:	
Course Coordinator	Dr. Sunil Kumar

Module	Course Content	No. of Hours
Module-1	Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.	**02**
Module-2	Grain Size determination of a given specimen.	**02**
Module-3	Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, cooper etc.)	**02**
Module-4	Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.	**02**
Module-5	Material identification of say 50 common items kept in a box.	**02**
Module-6	Faradays law of electrolysis experiment.	**02**
Module-7	Study of corrosion and its effects.	**02**
Module-8	Study of microstructure of welded component and HAZ. Macro & Micro examination.	**02**
Module-9	Other tests such as shear, bend tests on UTM.	**02**
Module-10	Hardness testing of given specimen using Rockwell and Vickers/Brinell testing machines.	**02**
Module-11	Spring index testing on spring testing machine.	**02**
Module-12	Fatigue testing on fatigue testing machine.	**02**
Total No. of Hours		**24**

Learning Outcomes:	Ability to apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials. Ability to function on multi-disciplinary teams in the area of materials testing. Ability to use the techniques, skills and modern engineering tools necessary for engineering. Understanding of professional and ethical responsibility in the areas of material testing. Ability to communicate effectively the mechanical properties of materials.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Course Code: BME-C358
Course Name: Engineering Mechanics Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Prerequisites:	NIL
Objectives:	
Course Coordinator	Mr. Kapil Dev Sharma

Module	Course Content	No. of Hours
Module-1	To determine the efficiency of a machines	**02**
Module-2	. To determine the mechanical advantage and efficiency of screw jack	**02**
Module-3	To measure coefficient of friction of different surfaces	**02**
Module-4	To study the forces acting on trusses	**02**
Module-5	To study the moment of inertia of a flywheel	**02**
Module-6	To study Lami's theorem using universal force table apparatus	**02**
Module-7	To study the equilibrium of parallel forces – simply supported beam reactions	**02**
Module-8	To determine the velocity ratio, mechanical advantage and efficiency of worm and worm wheel.	**02**
Module-9	To verify the parallelogram law of forces.	**02**
Module-10	To verify the moment area theorem for slope and deflection of beam.	**02**
Module-11	To study and verify the behavior of struts with various end conditions.	**02**
Module-12	To study the performance of differential axle and wheel and find its velocity ratio, efficiency and law of machine.	**02**
Total No. of Hours		**24**

Learning Outcomes:	**Understand** the fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems. **Apply** the fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems. **Design** Mechanical Design and Structural Analysis **Solve** the problems of simple system with sliding friction and calculate linear and angular acceleration of moving body in general plane motion. **What** is scalar and vector analytical techniques for analysing forces in statically determinate structures.

Course Code: BME-C359
Course Name: Fluid Mechanics Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Prerequisites:	NIL
Objectives:	1. To obtain resultant of various forces. 2. To calculate support reactions through conditions of equilibrium for various structures. 3. To understand role of friction in equilibrium problems. 4. To know fundamental laws of machines and their applications to various engineering problems
Course Coordinator	Mr. Yogesh Kumar

Module	Course Content	No. of Hours
Module-1	To determine the metacentric height of a ship model experimentally.	**02**
Module-2	To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.	**02**
Module-3	To verify the Bernoulli's theorem.	**02**
Module-4	To calibrate an orifice meter and venture meter and to study the variation of the coefficient of discharge with the Reynolds number.	**02**
Module-5	To calibrate and to determine the coefficient of discharge for rectangular and triangular notches.	**02**
Module-6	To determine the loss coefficients for the various pipe fittings.	**02**
Module-7	To study the flow behavior in a pipe bend and to calibrate the pipe bend for discharge measurement	**02**
Module-8	To measure the surface tension of a liquid.	**02**
Module-9	To determine the coefficients of velocity, contraction and discharge of an orifice (or a mouth piece) of a given shape. To plot the flow net for a given model using the concept of electrical analogy	**02**
Module-10	To verify Darcy's law and to find out the coefficient of permeability of the given medium	**02**
Module-11	To study the variation of friction factor, 'f' for turbulent flow in smooth and rough commercial pipes	**02**
Module-12	To verify the momentum equation.	**02**
Total No. of Hours		**24**

Learning Outcomes:	At the end of this course students will be able to: ❖ Understand the knowledge about the basic terminologies and will able to find out various conditions related to stability of floating bodies. ❖ Understand the knowledge about the fluid motion and will be able to distinguish between them based on Reynolds no. ❖ Apply Bernoulli's equation in flow measuring devices together with there calibration

Course Code: BME-C411
Course Name: FLUID MACHINES

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Basic Knowledge of Fluid Mechanics
Objectives:	This course offers basic knowledge on fluid statics, dynamics and hydraulic machines. The objective of this course is to enable the student to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.
Course Coordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit/Module	**Course Content**	**No. of Hours**
Unit-1/Module-1	**Introduction:** Classification of Fluid Mechanics, Application of momentum and momentum equation to flow through hydraulic machinery, Euler s fundamental equation.	**6**
Unit-2/Module-2	**Impact of Jet:** Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), effect of inclination of jet with the surface. **Hydraulic Turbines:** Classification of turbines, Impulse turbines, constructional details, velocity, triangles, power and efficiency calculations, governing of Pelton wheel.	**8**
Unit-3/Module-3	**Reaction Turbines:** Fransis and Kaplan turbines, constructional details, velocity triangles, power and efficiency calculations, degree of reaction, draft tube, cavitation in turbines,	**6**
Unit-4/Module-4	**Centrifugal Pumps:** Classifications of centrifugal pumps, vector diagram, work done by impellor, efficiencies of centrifugal pumps, specific speed, model testing, cavitation and separation, performance characteristics.	**6**
Unit-5/ Module-5	**Positive Displacement Pumps:** Reciprocating pump theory, slip and coefficient of discharges, indicator diagram, effect and acceleration, work saved by fitting air vessels, comparison of centrifugal and reciprocating pumps, positive rotary pumps, Gear and Vane pumps, performance characteristics	**8**

Unit-5/Module-5	**Other Machines:** Hydraulic accumulator, Intensifier, Hydraulic press, Lift and Cranes, theory of hydraulic coupling and torque converters, performance characteristics. Water Lifting Devices: Hydraulic ram, Jet pumps, Airlift pumps.	**6**
Total No. of Hours		**40**

Learning Outcomes:	❖ identify importance of various fluid properties at rest and in transit. ❖ derive and apply general governing equations for various fluid flows ❖ understand the concept of boundary layer theory and flow seperation. ❖ plot velocity and pressure profiles for any given fluid flow. ❖ evaluate the perfomance characteristics of hydraulic turbines and pumps.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.	1998
2.	Hydraulic Machines: Theory & Design, V.P.Vasandhani, Khanna Pub.	2002
3.	Hydraulic Machines by R K Rajput, S.Chand & co Ltd.	2006

Course Code: BME-C407
Course Name: Manufacturing Science and Processes

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	NILL
Objectives:	

Course Coordinator	Dr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit/Module	Course Content	No. of Hours
Unit1/Module-1	Introduction: Importance of manufacturing. Economic & technological considerations in manufacturing. Survey of manufacturing processes. Materials & manufacturing processes for common items. Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.	**8**
Unit-2/Module-2	Metal Forming Processes I: Elastic & plastic deformation, yield criteria. Hot working vs cold working. Load required to accomplish metal forming operation. Analysis (equilibrium equation method) of forging process with sliding friction sticking friction and mixed condition for slab and disc. Work required for forging, Hand, Power, Drop Forging. 4 Metal Forming Processes II: Analysis of Wire/strip drawing and max. reduction, Tube drawing, Extrusion and its application. Condition for Rolling force and power in rolling. Rolling mills. Design, lubrication and defects in metal forming.	**8**
Unit-3/Module-3	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	**8**
Unit-4/Module-4	Resins Powder Metallurgy: Powder metallurgy manufacturing process. The process, advantage and applications.Jigs & Fixtures: Locating &	**8**

	clamping devices/principle. Jigs and Fixtures and its applications. 4 Manufacturing of Plastic Components: Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications& Adhesives.	
Unit-5/Mpdule-5	**Metal forming processes:** Unconventional metal forming **Introduction to non-conventional Machining:** Benefits, application and working principle of EDM, ECM, LBM, EBM, USM.AJM,WJM **Unconventional** processes such as explosive forming, electro- magnetic, electro-hydraulic forming.	**8**
Total		**40**

Learning Outcomes:	Select Appropriate Manufacturing Processing to manufacture any component. Interpret foundry practices like pattern making, mould making, Core making and Inspection of defects. Extrusion and drawing process. Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging. Classify different plastic moulding processes, Extrusion of Plastic and thermoforming. Select Appropriate Joining Processes to join Work piece. Design different sheet metal working processes. Demonstrate operation such as Turning, Facing, Threading, Knurling and Grooving on Centre Lathe. Implement the Knowledge of Gained Subject in Industry Thermoforming.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	DeGarmo, E. P., Black, J.T., and Kohser, R.A., "Materials and Processes in Manufacturing", Prentice-Hall of India,ISBN-10: 0470924675.	1997
2.	Kalpakjian, S., and Schmid, S.R., "Manufacturing Engineering and Technology", Pearson Education,ISBN-10: 0133128741.	2000
3.	Groover, M.P., "Fundamentals of Modern Manufacturing", John Wiley & Sons, ISBN-10: 0470467002.	2002
4.	Lindberg, R.A., "Processes and Materials of Manufacture", PrenticeHall of India, ISBN-10: 9788120306639.	1990

Course Code: BME-C409
Course Name: Strength of Material

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	NILL
Objectives:	

Course Coordinator	Dr. Mayank Pokhriyal/ Dr Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit/Module	Course Content	No. of Hours
Unit1/Module-1	Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, elastic constants and their relations, volumetric, linear and shear strains, principal stresses and principal planes, Mohr's circle.	**8**
Unit-2/Module-2	Beams and types of beams, transverse loading on beams, shear force and bending moment diagrams, Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.	**8**
Unit-3/ Module-3	Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems .	**8**
Unit-4/Module-4	Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs	**8**
Unit-5/Module-5	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.	**8**
Total No. of Hours		**40**

Learning Outcomes:	❖ To get the knowledge of properties of material, stress, thermal stress and various mechanical components. ❖ Able to understand how different components will fail under load with help of theories of failure for brittle and ductile materials. ❖ Able to apply concepts of stress, strain, principle stress in 1D, 2D and 3D objects and also able to apply stress functions, and calculate stresses in plates and shells, thick circular cylinders and discs and employ contact stresses and stress concentration knowledge ❖ Able to analyze the different methods of unsymmetrical bending analysis and concept of shear center ❖ Able to evaluate force, stress and displacement in simple structures with use of energy methods. ❖ Able to create stress-strain model for any mechanical component.

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bedi, D.S., Strength of Materials, Khanna Publishing, Delhi, ISBN-10: 9382609113.	2013
2.	Rajput, R.K., Strength of Materials, Laxmi Publications, ISBN-10: 9788131808146.	2018
3.	Sadhu Singh, Strength of Materials, Khanna Publication, ISBN-978-81-7409-048-5.	1978
4.	Subramanian R.,Strength of Materials, , Oxford Publications, ISBN-10: 0198061102.	2010
5.	Crandall, S.H., Dahl, N.C., and Lardner, T.J., "An Introduction to the Mechanics of Solids", 2nd Ed., McGraw-Hill, ISBN-10: 0070134413.	1978

BKT-A403

BHARTIYA GYAN PARAMPARA
(INDIAN KNOWBLEDGE
TRADITION)

MM: 100 **Sessional: 30**
Time: 3 Hr. **ESE: 70**
L T P **Credit : 0**
2 0 0

इकाई प्रथम

1- वैदिक एवं लौकिक साहित्य का परिचय एवं उसका उद्देश्य। (वैदिक साहित्य, आर्ष साहित्य एवं स्मृति साहित्य)
2- वैदिक प्रार्थनाएं- गायत्री, भद्रप्राप्ति, शांति, संगठन, सौमनस्य एवं पंच महायज्ञ का सामान्य परिचय।
3- ब्रह्मचर्य महिमा, वैदिक राष्ट्रभक्ति एवं शिव संकल्प। (ब्रह्मचर्य सूक्त- अथर्ववेद 11.5 , पृथ्वी सूक्त- अथर्ववेद 12.1 , शिवसंकल्प सूक्त – यजुर्वेद 34.1-6 में वर्णित विषय वस्तु के आधार पर)

इकाई द्वितीय

1- वैदिक कालीन सामाजिक एवं शिक्षा व्यवस्था।
2- संस्कारों की जीवन में उपयोगिता।
3- पुरुषार्थ चतुष्टय – धर्म, अर्थ, काम, मोक्ष।

इकाई तृतीय

1- त्रैतवाद- ईश्वर, जीव और प्रकृति का स्वरूप।

2- कर्म एवं पुनर्जन्म सिद्धांत। (कर्म, निष्काम कर्म-योग एवं कर्मफल सिद्धांत)

इकाई चतुर्थ

1- मानव जीवन के विकास में योग की महत्ता।
2- अष्टांग योग – यम, नियम, आसन, प्राणायाम, प्रत्याहार, धारणा, ध्यान, समाधि।

इकाई पंचम

1- भारतीय संस्कृति एवं सभ्यता - एक परिचय।
2- ऋषि दयानंद एवं स्वामी श्रद्धानंद का व्यक्तित्व एवं कृतित्व।
3- आर्य समाज की स्थापना, उद्देश्य एवं कार्य। (सामाजिक जनजागरण, अछूत्तोद्धार, महिला शिक्षा, शुद्धि आंदोलन, सामाजिक कुरीतियों का उन्मूलन, स्वतंत्रता संग्राम में योगदान)

सहायक पुस्तकें

1. वैदिक साहित्य एवं सस्कृति, डॉ0 कपिल देव द्विवेदी।
2. उपनिमाद दीपिका, डॉ0 रामनाथ वेदालंकार।
3. वैदिकदर्शन, डॉ0 कपिल देव द्विवेदी, विश्वविद्यालय प्रकाशन वाराणसी
4. प्राचीन भारत तथा सामाजिक एवं आर्थिक इतिहास, डॉ0 देवेन्द्र गुप्ता, भारतीय बुक कौपोरेशन नई दिल्ली।
5. योगदर्शन, स्वामी रामदेव, पतंजलि योगपीठ हरिद्वार।
6. सत्यार्थ प्रकाश, स्वामी दयानन्द।
7. आर्यसमाज का इतिहास, डॉ0 सत्यकेतु विद्यालंकार।
8. भारतीय नवजागरण के पुरोधा, डॉ0 भवानी लाल भारतीय
9. संस्कृत साहित्य का इतिहास, डॉ0 कपिल देव द्विवेदी, विश्वविद्यालय प्रकाशन वाराण

Course Code: BME-C451
Course Name: Fluid Machines Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Prerequisites:	Knowledge of Fluid Mechanics
Objectives:	To examine the properties of fluids and to conduct experiments involving both incompressible and compressible flow.
Course Coordinator	Mr. Yogesh Kumar

Module	Course Content	No. of Hours
Module-1	Impact of Jet experiment..	**02**
Module-2	Turbine exp. on Pelton wheel..	**02**
Module-3	Turbine exp. on Francis turbine.	**02**
Module-4	Turbine exp. on Kaplan turbine..	**02**
Module-5	Experiment on Reciprocating pump..	**02**
Module-6	Experiment on centrifugal pump.	**02**
Module-7	Experiment on Hydraulic Jack/Press	**02**
Module-8	Experiment on Hydraulic Brake.	**02**
Module-9	Experiment on Hydraulic Ram	**02**
Module-10	Study through first visit of any pumping station/plant	**02**
Module-11	Study through second visit of any pumping station/plant	**02**
Module-12	Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines	**02**
Total No. of Hours		**24**

Learning Outcomes:	At the end of this course students will be able to: ❖ Understand the Impact of jet on Flat and curved vanes ❖ Examine the operating charecteristics of kaplan, turbine. ❖ Examine the operating characteristics of Francis turbine. ❖ Examine the efficiency of centrifugal and reciprocating pumps

Course Code: BME-C457

Course Name: Manufacturing Science and Process Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Prerequisites:	NIL
Objectives:	NIL
Course Coordinator	Dr. Sunil Kumar

Module	Course Content	No. of Hours
Module-1	Design of pattern for a desired casting (containing hole)	**02**
Module-2	Pattern making	**02**
Module-3	Making a mould (with core) and casting.	**02**
Module-4	Sand testing (at least one such as grain fineness number determination)	**02**
Module-5	Injection moulding with plastics	**02**
Module-6	Forging hand forging processes	**02**
Module-7	Forging - power hammer study & operation	**02**
Module-8	Tube bending with the use of sand and on tube bending m/c.	**02**
Module-9	Press work experiment such as blanking/piecing, washer, making etc.	**02**
Module-10	Wire drawing/extrusion on soft material.	**02**
Module-11	Rolling-experiment.	**02**
Module-12	Bending & spring back.	**02**
Total No. of Hours		**24**

Learning Outcomes:	Select Appropriate Manufacturing Processing to manufacture any component. Interpret foundry practices like pattern making, mould making, Core making and Inspection of defects. Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging. Classify different plastic moulding processes, Extrusion of Plastic and Thermoforming. Design different sheet metal working processes.

NOTE

1. In practical examination the students shall be required to perform one experiment
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consists of more than 20 students
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

Course Code: BME-C459

Course Name: Machine Drawing Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**
Prerequisites:	Engineering Graphics and Design
Objectives:	NIL
Course Coordinator	Dr. Mayank Pokhriyal

Module	Course Content	No. of Sheets
Module-1	Introduction, classification of machine drawings, principles of drawing, conventional representation of machine components and materials, lines types of lines, dimensioning types, lines and rules of dimensioning. Orthographic Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing line problems, principle of visualization of objects, sectional views, full and half sectional views, auxiliary views.	**05**
Module-2	Fasteners Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints.	**03**
Module-3	Riveted joints Introduction, rivets and riveting, types of rivets, types of riveted joints, drawing of boiler joints etc. Free hand sketching (1 drawing sheet) Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.	**03**
Module-4	Assembly drawing Introduction to assembly drawing, drawing assembly drawing of simple machine elements like rigid or flexible coupling, muff coupling, Plummer block, footstep bearing, bracket etc.	**03**

Module-5	Computer aided drafting(2 drawing sheets) Introduction to computer aided drafting; advantages and applications of CAD, concepts of computer aided 2D drafting using any drafting software like AutoCAD, Solid Edge, Solid Works etc., basic draw and modify commands, making 2D drawings of simple machine parts.	**02**
Total		**16**

Learning Outcomes:	Upon successful completion of a Machine Drawing Lab course, students will be able to create and interpret engineering drawings, understand standards and conventions, and use CAD software for 2D and 3D modeling of machine components.

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	French, T.E., Vierck, C.J., and Foster, R.J., "Engineering Drawing and Graphic Technology", 14th Ed., McGraw-Hill, ISBN-10: 0070223475.	1993
2.	Giesecke, F.E., Mitchel, A., Spencer, H.C., Hill, I.L., Dygdon, J.T., Novak, J.E., and Lockhart, S.D., "Technical Drawing", 13th Ed., Prentice-Hall, ISBN:0135135273.	2008
3.	Lakshminarayanan, V., and Mathur, M.L., "Text Book of Machine Drawing (with Computer Graphics)", 12th Ed., Jain Brothers,ISBN: 8186321330.	2007

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.

Course code: BME-C514
Course Name: Heat Transfer & Thermal Machines

MM: 100 **Time:4** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Fundamental knowledge of Thermodynamics
Objectives:	1. Basic Concepts of Heat Transfer 2. Design and Rating of Heat exchangers with and Without Phase Change. 3. Design and Rating of Compact Heat Exchangers
Course Coordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Introduction:** Three modes of heat transfer; Examples of equipment (like air conditioner and air cooler) involving heat transfer; Derivation of heat balance equation.	**8**
UNIT-2	*Module -2*	**Conduction Heat Transfer:** Steady 1D 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; 2D conduction solutions for steady and unsteady heat transfer.	8
UNIT-3	*Module -3*	**Convection Heat Transfer:** 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 for internal and external flow; Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	8

UNIT-4	*Module-4*	**Radiation Heat Transfer:** Interaction of radiation with materials; Definitions of radiative properties; Stefan Boltzmann's law; Black and grey body radiation; Calculation of radiation heat transfer between surfaces using radiative properties; View factors and the radiosity method; Examples for two-body enclosures; Radiation shield.	8
UNIT-5	*Module-5*	**Heat Exchanger Design:** Function, classification and configuration of heat exchangers; Evaluation of mean temperature difference; Heat exchanger effectiveness; Analysis, design and selection of heat exchangers.	**4**
	Module-6	**Boiling and Condensation Heat Transfer:** Pool boiling; Flow boiling; Film and drop wise condensation.	**2**
	Module-7	**Introduction to mass transfer:** Analogy between heat and mass transfer; Mass diffusion; Fick's Law; Steady and transient mass diffusion; Simultaneous heat and mass transfer.	2
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer 2. 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 3. Design heat exchangers and estimate the insulation needed to reduce heat losses where necessary.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company. ISBN-0071001328	1998
2.	Heat Transfer By J.P. Holman, McGraw-Hill International edition. ISBN 0070586748	2004
3.	Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition ISBN-9780071764292	2011
4.	F.P. Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer," John Wiley,	2019

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Course Code: BME-C515

Course Name: Kinematics and Dynamics of Machines

MM: 100 **Time: 4 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	NIL
Objectives:	1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components 2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link 3. To be able to design linkage mechanisms and cam systems to generate specified output motion 4. To understand the kinematics of gear trains

Course Coordinator	Mr. Kapil Dev Sharma
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit		Course Content	No. of Hours
UNIT-1	*Module-1*	**Mechanisms:** Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Common mechanisms such as slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms, etc.	**8**
UNIT-2	*Module-2*	**Basic Kinematic Concepts and Definitions:** Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage; Transmission angle; Limit positions	4
	Module-3	**Geometric Design of Mechanisms:** Graphical synthesis of dyads and crank-rocker for two- and three-position synthesis for path and motion generation.	4
UNIT-3	*Module-4*	**Kinematic Analysis of Simple Mechanisms:** Displacement, velocity, and acceleration analysis; Velocity analysis using instantaneous centers; Position, velocity and acceleration analysis using loop closure equations; Coincident points; Coriolis component of acceleration.	8

	Module-5	**Static and Dynamic Force Analysis of Simple Mechanisms:** Two & three force members; Force & moment equilibrium; Inertial forces; Equations of motion for force-bar and slider-crank mechanisms.	
UNIT-4	*Module-6*	**Cams and Followers**: Classification and terminology; Displacement, velocity, acceleration and jerk diagrams; Uniform velocity, parabolic, simple harmonic and cycloidal motions; Derivatives of follower motions; Circular and tangent cams; Pressure angle and undercutting; Graphical and analytical disc cam profile synthesis for roller and flat face followers.	8
UNIT-5	*Module-7*	**Gears:** Involute and cycloidal profiles; gear parameters; Fundamental law of gearing and conjugate action; Spur gear contact ratio and interference; Helical, bevel, worm, rack & pinion gears; Epicyclic and regular gear train kinematics; Force analysis of spur, helical, bevel and worm gearing. **Computer-aided simulation of simple mechanisms.**	**8**
Total			**40**

COS	**1.Explain** the working of inversions of four bar, single slider and double slider chain, working of cam and follower arrangement, working of gear trains, Involute and cycloidal gear, interference, and Universal Hook's joint. **2.Define** Kinematic Link, Kinematic Pair, Kinematic chain, Gear, Gear train, cam and follower, brake, clutch, belt, Gasthof's law, Kennedy's theorem, Under cutting **3.Determine** velocity and acceleration of various links in different kinematic chain, different 4. **Compare** compound and epicyclic gear train, sliding and roller follower, single plate and double plate clutch, flat and V- belt, four bar and single slider chain, pivot and collar Bearings.llower, torque required in brake and bearing, Gear ratio, Size of gear **5.Classify** the types of links, types of kinematic pairs, types of gear trains, types of cams and follower, types of belts. **6.Design** Various kinematic chains and inversions, Cams under different condition of motion

Suggested Books

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	1. Martin, G.H., “Kinematics and Dynamics of Machines”, 2nd Ed., McGraw-Hill,ISBN13: 978-1577662501.	1982
2.	2. Vinogradov, O., “Fundamentals of Kinematics and Dynamics of Machines and Mechanisms”, CRC Press, ISBN 9780849302572.	2000
3.	Massie, H.H., and Reinholtz, C.F., “Mechanisms and Dynamics of Machinery, 4th Ed., John Wiley & Sons, ISBN: 978-0-471-80237-2.	1987
4.	. Vicker, J.J., Shigley, J.E., and Pennock, G.R., “Theory of Machines and Mechanisms”, 3rd Ed., Oxford University Press,ISBN-13: 978-0195371239.	2003
5.	Hannah, J., and Stephens, R.C., “Mechanics of Machines : Elementary Theory and Examples”, 4th Ed., Viva Books, ISBN-10: 0713132329.	2004

Course Code: BME-C512
Course Name: Measurement & Metrology

MM: 100 **Time:3H** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic Knowledge of Metric and SI unit of physical quantities, Statistics.
Objectives:	1. This course provides standard methodology for inspection and also discusses the equipment required for the inspection process so as to see that the designer's specifications are met. 2. To understand the statistical concepts in quality control and quality assurance and to appreciate the concepts of on-line and off-line quality control in today's Manufacturing, subsequently applying these concepts to various situations through problem solving.
Course Coordinator	Dr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shallcontain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Introduction to Metrology and its relevance, importance of dimensional measurement, line and end standards. Need of inspection, sources of errors, basic types of errors precision and accuracy. Method of estimating accuracy and precision, standard and their evolutions. Simple measurement tools: Rules, calipers, height gauges, micrometers, depth gauge dial indicator, slip gauges, sine bar.	**08**
UNIT-2	*Module-2*	**Limits, fits and tolerances-** interchangeability, selective assembly, limits of size, types of fits, Indian standard specifications for the design fits. Limit gauging- Taylor's principles of limit gauging, design of gauges, classification of gauges. Interferometers: Types of light sources and interferometers, Types of scale and grading, optical flats.	**08**

UNIT-3	*Module-3*	**Metrology of Screw Thread Gear Metrology**: Gear error, Gear measurement, Gear Tooth Vernier; Profile Projector, Tool markers microscope. Advancements in Metrology: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology.	**08**
UNIT-4	*Module-4*	**Metrology and Inspection:** Standards of linear measurement, line and end standards.	**04**
	Module-5	Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.	**04**
UNIT-5	*Module-6*	**Measurement of Geometric Forms:** Straightness, flatness, roundness.Tool makers microscope,profile project autocollimator. Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears, Surface texture: quantitative evaluation of surface roughness and its measurement.	**08**
Total No. of Hours			**40**

Learning Outcome:	At the end of the course students are able to: 1. Identify techniques to minimize the errors in measurement 2. Identify methods and devices for measurement of length, angle, and gear and threadparameters, surface roughness and geometric features of parts. 3. Choose limits for plug and ring gauges. 4. Explain methods of measurement in modern machineries 5. Select quality control techniques and its applications 6. Plot quality control charts and suggest measures to improve the quality of productand reduce cost using Statistical tools.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	R. K. Jain, Engineering Metrology**,** Khanna Publications, 17th edition.ISBN-9788174091536	1975
2.	V. A. Kulkarni, A. K. Bewoor, Metrology & Measurements, Tata McGraw Hill Co. Ltd., 1st edition. ISBN-9788126519071	2009
3.	Gupta. I.C., "Engineering Metrology", Dhanpat Rai Publications. ISBN-8189928457	2005

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Course Code: BME-C516

Course Name: Machine Element & System Design

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	NIL
Objectives:	1. To understand safety-critical design of machine components using failure criteria based on mechanics of materials 2. To understand the origins, nature and applicability of empirical design principles, relevant codes, standards and design guidelines for different machine elements 3. To appreciate the relationships between component level design and overall machine system design and performance

Course Coordinator	Dr. Sanjeev Kumar Lambha
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit		Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Anatomy of machines; Functional dissection of motorcycle, washing machine, sewing machine, etc. into machine elements including gears, rack and pinions, cams, chains, belts, pulleys, flywheels, bearings, shafts, keys, brakes, etc.; Design considerations – Limits, fits and standardization; Friction and lubrication.	**8**
UNIT-2	*Module-2*	**Free Body Diagrams:** Force analysis of machine elements and machine systems; Application to power screws and couplings, clutches, and brakes.	4
	Module-3	**Failure Theories:** Static failure theories including normal stress theory, shear stress theory, distortion energy theory; von Mises stress; Factor of safety; Stress concentration factors; Fatigue failure theories: mean and alternating stresses, yield, ultimate, and endurance strength; Goodman, Gerber, and Soderberg lines.	**4**

UNIT-3	*Module-4*	**Design of Machine Elements:** *Springs* – Helical compression, tension, torsional and leaf springs; *Fasteners* – threaded fasteners, bolted joints, preloaded bolts, rivets and welded joints; *Shafts* – shafts under static and fatigue loadings; Keys; Sliding and rolling contact bearings; *Transmission elements* – transmission ratio and efficiency of spur, helical, bevel and worm gears; belt and chain drives; Flywheels.	8
UNIT-4	*Module-5*	**Vibrations of Machine Elements**: Single degree-of-freedom systems; Natural frequency and critical damping; Forced vibration; Resonance; Balancing of reciprocating and rotating masses; Torsional vibration and critical speeds of shafts.	8
UNIT-5	*Module-6*	**Mechanical Systems:** Case studies on automobile suspensions, automatic transmissions, material conveyor systems, construction machinery, etc.	**8**
Total			**40**

Online Resources:

1 https://archive.nptel.ac.in/courses/112/105/112105124/

COS	1. Principles of machine elements and how they can be combined to function as a system 2. Failure analysis of machine elements 3. An overview of codes, standards and design guidelines for different elements 4. Ability to analyse mechanical systems.

Suggested Books

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Shigley, J.E. and Mischke, C.R., "Mechanical Engineering Design," McGraw-Hill,	1989
2.	Deutschman, D., & Wilson, C.E., "Machine Design Theory & Practice," Macmillan,	1992
3.	Juvinal, R.C., "Fundamentals of Machine Component Design," John Wiley,	1994
4.	Spottes, M.F., "Design of Machine elements," Prentice-Hall India,	1994
5.	R. L. Norton, "Mechanical Design – An Integrated Approach," Prentice Hall,	2009
6.	Sadhu Singh, "Machine Design", Khanna Book Publishing,	2021
7.	Sadhu Singh, "Machine Design Data Book", Khanna Book Publishing, 2022.	2022

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Course Code: BME-M001

Course Name: Universal Human Values

MM: 100 **Time: 3** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 0**
Prerequisites:	Moral Education
Objectives:	This introductory course input is intended: 1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. 2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. 3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature. Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction to Value Education (6 lectures and 3 tutorials for practice session)** **Lecture 1:** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) **Lecture 2:** Understanding Value Education **Tutorial 1**: **Practice Session PS1** Sharing about Oneself **Lecture 3:** Self-exploration as the Process for Value Education **Lecture 4:** Continuous Happiness and Prosperity – the Basic Human Aspirations **Tutorial 2: Practice Session PS2** Exploring Human Consciousness **Lecture 5:** Happiness and Prosperity – Current Scenario **Lecture 6:** Method to Fulfill the Basic Human Aspirations **Tutorial: Practice Session PS3** Exploring Natural Acceptance	**8**
UNIT-2	*Module-2*	**Harmony in the Human Being (6 lectures and 3 tutorials for practice session)** **Lecture 7:** Understanding Human being as the Co-existence of the Self and the Body **Lecture 8:** Distinguishing between the Needs of the Self and the Body **Tutorial 4: Practice Session PS4** Exploring the difference of Needs of Self and Body **Lecture 9:** The Body as an Instrument of the Self **Lecture 10:** Understanding Harmony in the Self **Tutorial 5: Practice Session PS5** Exploring Sources of Imagination in the Self **Lecture 11:** Harmony of the Self with the Body **Lecture 12:** Programme to ensure self-regulation and Health **Tutorial: Practice Session PS6** Exploring Harmony of Self with the Body	**8**

UNIT-3	*Module-3*	**Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)** **Lecture 13:** Harmony in the Family – the Basic Unit of Human Interaction **Lecture 14:** 'Trust' – the Foundational Value in Relationship **Tutorial 7: Practice Session PS7** Exploring the Feeling of Trust **Lecture 15:** 'Respect' – as the Right Evaluation **Tutorial 8: Practice Session PS8** Exploring the Feeling of Respect **Lecture 16:** Other Feelings, Justice in Human-to-Human Relationship **Lecture 17:** Understanding Harmony in the Society **Lecture 18:** Vision for the Universal Human Order **Tutorial: Practice Session PS9** Exploring Systems to fulfil Human Goal	**8**
UNIT-4	*Module-4*	**Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)** **Lecture 19:** Understanding Harmony in the Nature **Lecture 20:** Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature **Tutorial 10: Practice Session PS10** Exploring the Four Orders of Nature **Lecture 21:** Realizing Existence as Co-existence at All Levels **Lecture 22:** The Holistic Perception of Harmony in Existence **Tutorial: Practice Session PS11** Exploring Co-existence in Existence	**8**
UNIT-5	*Module-5*	**Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)** **Lecture 23:** Natural Acceptance of Human Values **Lecture 24:** Definitiveness of (Ethical) Human Conduct **Tutorial 12: Practice Session PS12** Exploring Ethical Human Conduct **Lecture 25:** A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order **Lecture 26**: Competence in Professional Ethics **Tutorial 13: Practice Session PS13** Exploring Humanistic Models in Education **Lecture 27:** Holistic Technologies, Production Systems and Management Models-Typical Case Studies **Lecture 28:** Strategies for Transition towards Value-based Life and Profession **Tutorial: Practice Session PS14** Exploring Steps of Transition towards Universal Human Order	**8**
Total No. of Hours			**40**

Learning Outcomes:	1. By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature). 2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). 3. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. 4. This is only an introductory foundational input. It would be desirable to follow it up by faculty-student or mentor-mentee programs throughout their time with the institution. 5. Higher level courses on human values in every aspect of living. E.g. as a professional.

Guidelines and Content for Practice Sessions (Tutorials)

In order to connect the content of the proposals with practice (living), 14 practice sessions have been designed. The full set of practice sessions is available in the Teacher's Manual as well as the website.

Practice Sessions for Module 1 – Introduction to Value Education

PS1 Sharing about Oneself

PS2 Exploring Human Consciousness

PS3 Exploring Natural Acceptance

Practice Sessions for Module 2 – Harmony in the Human Being

PS4 Exploring the difference of Needs of Self and Body

PS5 Exploring Sources of Imagination in the Self

PS6 Exploring Harmony of Self with the Body

Practice Sessions for Module 3 – Harmony in the Family and Society

PS7 Exploring the Feeling of Trust

PS8 Exploring the Feeling of Respect

PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for Module 4 – Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature

PS11 Exploring Co-existence in Existence

Practice Sessions for Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct

PS13 Exploring Humanistic Models in Education

PS14 Exploring Steps of Transition towards Universal Human Order

As an example, PS7 is a practice session in module 3 regarding trust. It is explained below: **[[**

PS7: Form small groups in the class and in that group initiate dialogue and ask the eight questions related to trust. The eight questions

1b. Am I able to make myself always happy?

are: 1a. Do I want to make myself happy?
2a. Do I want to make the other happy?
3a. Does the other want to make him happy?
4a. Does the other want to make me happy?
Intention (Natural Acceptance)
What is the answer?

2b. Am I able to make the other always happy?
3b. Is the other able to make him always happy?
4b. Is the other able to make me always happy?
Competence
What is the answer?

S. No.	Name of Authors /Books /Publisher	Year of Publication
1	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi. ISBN 978-93-87034-47-1	2019
2	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-,	2019
3	Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi.	2022

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Course Code: BME-O541

Course Name: MOOCs-III (Swayam /NPTEL) Course

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	NIL
Objectives:	--

Course Coordinator	Dr. Jasbir Singh
NOTE:	***The MOOCs courses shall be studied by the student through SWAYAM/NPTEL. Students have to study from Online Platform doubt sessions shall be held by Internal teachers. Students have to attempt the exams for these MOOC courses conducted by SWAYAM/NPTEL for credit transfer as per university policy.***

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Course Code: BME-C564

Course Name: Mechanical Engineering Lab (Heat Transfer & Thermal Analysis)

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites :	Fundamental knowledge of Thermodynamics.
Objectives:	1. To impart practical knowledge on principles and performance characteristics of heat transfer, mass transfer in engineering systems. 2. To do the experiments related to their subjects like thermodynamics, thermal engineering, heat and mass transfer concepts.
Course Coordinator	Mr. Yogesh Kumar

Module	Course Content	No. of Hours
Experiment-1	Determination of the thermal conductivity and specific heat through composite wall apparatus.	**02**
Experiment-2	Determination of the thermal conductivity and specific heat through Composite cylinder apparatus.	**02**
Experiment-3	Determination of the convective heat transfer coefficient through Pool boiling apparatus.	**02**
Experiment-4	Determination of the convective heat transfer coefficient through tube-natural convection.	**02**
Experiment-5	Determination of the convective heat transfer coefficient through Convection - Heat Pipe experiment.	**02**
Experiment-6	Determination of the convective heat transfer coefficient through fin-natural convection.	**02**
Experiment-7	Determination of the convective heat transfer coefficient through tube/fin-forced convection.	**02**
Experiment-8	Determination of the emissivity of a given sample.	**02**
Experiment-9	Determination of the performance of Heat Exchanger - Parallel flow.	**02**
Experiment-10	Determination of the performance of Heat Exchanger - Counter flow experiment	**02**
Experiment-11	Determination of the calorific value of a given fuel and its flash & fire points.	**02**
Experiment-12	Determination of p-V diagram and the performance of a 4-stroke diesel engine.	**02**
Total		**24**

Learning Outcomes:	At the end of the course students are able to: 1. At the end of course students will learn to the calculation of heat transfer coefficient of heat flow through conduction and convection mode. 2. To be able to understand comparison of lagged cylinder and vertical pipe cylinder heat transfer in free convection. 3. To be able to understand heat exchanger as parallel flow and counter flow and find temperature distribution in heat exchanges, oversell heat transfer coefficient and efficiencies. 4. To learn and understand the superconductivity characteristics of heat pipe and plot graph 5. To be able to understand the emissivity of test plate with respect to black plate.

1. Each student shall be required to perform one experiment in the practical examination.
2. A Teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Every student shall have to perform minimum eight experiments during the semester.
6. Any Experiment based on syllabus may be added by permission of Head / Dean.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Fundamentals of Momentum, Heat and Mass Transfer by James R.Welty; John Wiley & Sons(Pvt).Ltd. ISBN: 978-1-119-49541-3	2019
2.	Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers ISBN10 8122408001	2016
3.	Heat Transfer, by Y.V.C. Rao, University Press., ISBN-8173713847	2001

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Course Code: BME-C565

Course Name: Mechanical Engineering (Design) Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**
Prerequisites:	NIL
Objectives:	1. To understand the measurement of mechanical properties of materials 2. To understand the deformation behaviour of materials 3. To understand the kinematic and dynamic characteristics of mechanical devices
Course Coordinator	Mr. Kapil Dev Sharma

Module	Course Content	No. of Hours
Experiment-1	Bending deflection test on beams	**02**
Experiment-2	Study of various types of models of kinematics links, pair and mechanism arrangements	**02**
Experiment-3	Study of various types of models of cam and follower arrangements	**02**
Experiment-4	Study of velocity ratios in various models of gear trains arrangements	**02**
Experiment-5	Experimental study of cam and follower and different motions.	**02**
Experiment-6	Experiment on Journal bearing apparatus	**02**
Experiment-7	Experiment on critical speed of shaft (whirling of shaft) apparatus	**02**
Experiment-8	Experiment on static Balancing Dynamic Balancing apparatus	**02**
Experiment-9	Study and Performance experiment on Porter Governor.	**02**
Experiment-10	Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient	**02**
Experiment-11	Experiment on Gyroscope apparatus	**02**
Experiment-12	Microscopic examination of heat-treated and untreated metallic samples	**02**
Total No. of Hours		**24**

Learning Outcome	Students who have undergone the course will be able to understand the measurement of mechanical properties of materials and will be able to characterize the dynamic behaviour of mechanical systems

NOTE:	Each student shall be required to perform one experiment in the practical examination. A Teacher shall be assigned 20 students for daily practical work in laboratory. No batch for practical class shall consist of more than 20 students. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. Every student shall have to perform minimum eight experiments during the semester. Any Experiment based on syllabus may be added by permission of Head / Dean.

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Course Code: BME-C562

Course Name: Measurement & Metrology Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Prerequisites:	NIL
Objectives:	To understand the proper use and maintenance of important instruments, such as Vernier callipers, autocollimators, slip gauges, and pyrometers
Course Coordinator	Dr. Mayank Pokhriyal

Module	Course Content	No. of Hours
Experiment-1	Study & working of simple measuring instruments. Like Vernier calipers, micrometer, tachometer etc.	**02**
Experiment-2	Measurement of effective diameter of a screw thread using 3- wire method	**02**
Experiment-3	Measurement of angle using sine bar & slip gauges.	**02**
Experiment-4	Study of angular measurement using level protector	**02**
Experiment-5	Pressure measuring experiment	**02**
Experiment-6	Temperature measurement experiment	**02**
Experiment-7	Measurement of the surface roughness.	**02**
Experiment-8	Force measuring experiment	**02**
Total No. of Hours		**16**

Learning Outcome:	At the end of the course students are able to: 1 Demonstrate the use of instruments for measuring linear (internal and external), angulardimensions and surface roughness. 2. Perform alignment tests on various machine tools. 3. Demonstrate the use of instruments for measuring pressure, flow, speed, displacementand temperature.

NOTE 1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean

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Course Code: BME-C570

Course Name: Project III (Summer Training Report)

MM: 50 **Time: 2Hr.** **L T P** **0 0 2**	**Sessional:15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of Different Machines.
Objectives:	1. The objective of the summer training and internship program on recent/ latest technologies is to make students acquire knowledge of latest technologies and also to work under the guidance of industry professionals. 2. Students will develop presentation, listening and communication skills 3. Students will develop Argumentative Skills and Critical Thinking. Course Outcomes: 4. Students will gain knowledge of the current and upcoming technologies. 5. Students will be able to look into the working environment in the industry.
Course Coordinator	Dr. Sunil Kumar

Students will develop better communication skills and critical thinking. The presentation will be held for the Summer Training and Internship program done in summer break on recent/ latest technologies after IV semester examination, a certificate of completion to be submitted along with the presentation in the department. In case, any student is unable to do an internship in some company, he is allowed to do any one extra online skill enhancement course, for which the course completion certificate along with the presentation has to be submitted in the department.

Learning Outcomes:	1. Students will gain knowledge of the current and upcoming technologies. 2. Students will be able to look into the working environment in the industry 3. Students will develop better communication skills and critical thinking.

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Course Code: BME-C611

Course Name: Computer Aided Design & Analysis

MM: 100 **Time: 4Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Nil
Objectives:	To provide an overview of how computers can be utilized in mechanical component design
Course Coordinator	Dr. Sanjeev Kumar Lambha/ Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Role of computers in design process; Computer aided design, analysis and manufacturing; Computer integrated manufacturing; Popular CAD software used in industry; Input and output devices.	**8**
UNIT-2	*Module-2*	**Transformations:** Matrix representation of points, lines and planes; 2D transformation for translation, scaling, rotation and reflection; Homogeneous representation & concatenation; 3D transformations.	**4**
	Module-3	**Curves and Surfaces:** Representation of curves; Hermite curves, Bezier curves, B-spline curves, Rational curves; Surface modelling – parametric representation, planar surface, surface of revolution, Coons and bicubic patches, Bezier and B-spline surfaces.	4
UNIT-3	*Module-4*	**Solid Modelling:** Solid modelling techniques – sweep (linear and curved), Boolean (constructive solid geometry) and other techniques; Solid model representation (Boundary and Constructive Solid Geometry); Medical modelling (pixels, scans and voxels); Exchange standards (IGES, DXF, STEP, STL etc.).	**8**

UNIT-4	*Module -5*	**Engineering Analysis:** Introduction to finite element method; Principle of potential energy; FE analysis of 1D element problems (spring, bar, truss elements); Development of element stiffness equation and their assembly; Plain strain and plain stress problems; Domain discretization, pre-processing and post-processing; Verification and validation; Popular CAE software used in industry	**8**
UNIT-5	*Module -6*	**Introduction to CFD and HT:** Basic theoretical framework, Boundary conditions, Application Examples: thermal and fluid machines.	**4**
	Module -7	**Design Optimization:** Purpose and application of optimum design, Primary and subsidiary design equations, Limit Equations, Normal, redundant and incompatible specifications problems; Computer-aided design optimization.	**4**
Total No. of Hours			**40**

Learning Outcomes:	Upon completion of this course, the students can use computer and CAD software for modelling and analyzing simple mechanical components

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Ibrahim Zeid, "Mastering CAD CAM," Tata McGraw Hill Publishing Co.	2007
2.	C. McMohan and J. Browne, "CAD/CAM Principles," Pearson Education, 2nd Edition.	1999
3.	Geometric Modeling, Michael E. Mortenson, Tata McGraw Hill.	2013
4.	W. M. Neumann and R.F. Sproul, "Principles of Computer Graphics," McGraw Hill.	1989
5.	D. Hearn and M.P. Baker, "Computer Graphics," Prentice Hall Inc.	1992

Online Resources:

1. NPTEL Lecture Series:
   - https://nptel.ac.in/courses/112/102/112102101/
   - https://nptel.ac.in/courses/112/104/112104031/
2. MIT OCW: https://ocw.mit.edu/courses/mechanical-engineering/2-158j-computational-geometry-spring-2003/

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Course Code: BME-C612

Course Name: Product Innovation & Entrepreneurship

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	To expose aspiring student entrepreneurs to various elements of a technology venture starting from market need identification to innovative solution development and its commercialization through business planning and start-up company incubation.
Course Coordinator	Mr. Praveen Kumar Pandey/ Dr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Product Innovation:** Opportunity scanning, market survey, need identification and problem definition; Creative design thinking for concept generation; Detailed design & prototyping; Functionality & manufacturability; Bill of materials & components supply chain; Manufacturing & assembly plan; Product testing & quality assurance; Intellectual property rights management.	**08**
UNIT-2	*Module -2*	**Entrepreneurship:** Role of entrepreneurship in economic development; Entrepreneurial mindset, motivation and competencies; Market pull and technology push factors; New product development lifecycle; Technology readiness levels; Product-market fit validation; Commercialization pathways; Business vision & leadership; Team composition & management.	**08**

UNIT-3	*Module -3*	**Marketing & Finance:** Market segmentation & market sizing; Customer persona & value proposition; Marketing (Go-to-market) strategy; Distribution channels and sales network; Funding requirement (based on stage); Source of funding for startup ventures; Financial projections and accounting; Startup to scale up financing.	**08**
UNIT-4	*Module -4*	**Venture Creation:** Sustainable business options & pathways; Business model & business canvas; Startup team & business partners; Startup ecosystem and stakeholders; Technology business incubators & parks; Proposal pitching & agreements; Startup company incorporation; Social impact & responsibility.	**08**
UNIT-5	*Module-5*	**Course Project:** Need identification, innovative solution, business plan, go-to-market strategy.	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Understand how to identify an unmet need through market research 2. Learn how to create an innovative solution and check problem-solution fit 3. Practice business planning, including marketing, fund-raising and start-up incubation.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bill Aulet, "Technology Entrepreneurship", 4th ed., Tata McGraw Hill.	2014
2.	Peter F. Drucker, "Innovation and Entrepreneurship", 1st ed., Harper Business, 2006.	2006
3.	Chelat Bhuvanachandran, Innovision, Khanna Book Publishing, 2022.	2022
4.	Byers, Dorf, and Nelson, Technology Ventures: From Ideas to Enterprise, McGraw Hill.	2010
5.	Steve Blank, "The Startup Owner's Manual"	
6.	T.V. Rao, "Entrepreneurship - A South Asian Perspective"	

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ge03/preview

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Course Code: BME-C 613

Course Name: Manufacturing Automation

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	1 To understand the importance of automation in the of field machine tool based manufacturing 2 To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC 3 To understand the basics of product design and the role of manufacturing automation
Course Coordinator	Dr. Sunil Kumar
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Definition; Reasons for automating; Strategies; Types of automation; Numerical control (NC, CNC, DNC); Introduction to CNC programming and computer-aided process planning.	4
	Module-2	**Machine and Process Automation:** CNC machines, Automated flow lines (types, selection); Work part transport and transfer mechanisms; Feedback systems and control; Modular and reconfigurable machines, adaptive machine controls.	**4**
UNIT-2	*Module-3*	**Automated Assembly Systems:** Historical developments; Choice of assembly methods; Design for automated assembly; Transfer systems; Vibratory and non-vibratory feeders; Feed tracks, part orienting and placing mechanisms.	**4**

	Module-4	**Factory Automation:** Lean manufacturing, Automation scalability (fixed, programmable, flexible and reconfigurable); Design and analysis of automated flow lines; Average production time, production rate, line efficiency; Analysis of transfer lines without storage; Partial and full automation.	**4**
UNIT-3	*Module-5*	**Automation Tools and Techniques:** Mechanical, electro-mechanical, pneumatic and hydraulic systems; Sensors integration; Process monitoring, data analysis and control using actuators; Robots (pick, place, assembly, welding, painting, etc.); Automatic Guided Vehicles; Automated inspection and measurement (CMM and 3D Scanning); Machine vision, AI and machine learning; Human-machine interfaces; Examples and case studies.	**8**
UNIT-4	*Module -6*	**Advanced Automation Trends:** Digital, inclusive, smart and distributed manufacturing; Industry 4.0; Digital transformations in shop-floors (CIM to Smart factory; Intelligent machines to Smart Machines; Factory automation to Distributed automation; Human sense to system sensed).	**8**
UNIT-5	*Module -7*	**Examples and Case Studies:** Pick and place robots, testing and sorting based systems, etc; Orientation of parts: in-bowl and out-of-bowl toolings; Manufacturing equipment embedded with digital data and driven by adoptive controls; Manufacturing automation with autonomous decisions taken by computers based on the realistic process/machines (production conditions) data acquired from the resources.	**8**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. To understand the importance of automation in manufacturing value chain 2. To get the knowledge of various elements of automation tools and techniques 3. To understand the emerging digital manufacturing trends propulsion.

Suggested books:

S.No.	Name of Authors /Books /Publisher	Year of Publication
1.	M. P. Groover, Automation, Production Systems and Computer-integrated Manufacturing, Prentice Hall.	2018
2.	S. Kalpakjian and S. R. Schmid, Manufacturing – Engineering and Technology, Pearson.	2001
3.	Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill.	2005
4.	CAD/CAM Principles and Applications, P.N. Rao, Tata McGraw Hill.	2010

Online Resources:

1. https://nptel.ac.in/courses/112/104/112104289/
2. https://nptel.ac.in/courses/112/103/112103293/
3. https://nptel.ac.in/courses/112/103/112103174/

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Course Code: BME-O641

Course Name: MOOCs-IV (Swayam /NPTEL) Course

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	NIL
Objectives:	

Course Coordinator	
NOTE:	***The MOOCs courses shall be studied by the student through SWAYAM/NPTEL. Students have to study from Online Platform doubt sessions shall be held by Internal teachers. Students have to attempt the exams for these MOOC courses conducted by SWAYAM/NPTEL for credit transfer as per university policy.***

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Course Code: BME-C661

Course Name: Mechanical Engineering (Manufacturing) Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of Machine Elements.
Objectives:	1. To provide an understanding of advanced manufacturing methods. 2. 2. To get an idea of the dimensional & form accuracy of products.
Course Coordinator	Dr. Sunil Kumar/ Mr. Rishi Kumar Prajapati

Module	Course Content	No. of Hours
Experiment-1	Taper turning and external thread cutting using lathe	**02**
Experiment-2	Contour milling using vertical milling machine	**02**
Experiment-3	Spur gear cutting in milling machine	**02**
Experiment-4	Measurement of cutting forces in Milling/ Turning process	**02**
Experiment-5	CNC part programming	**02**
Experiment-6	Drilling of a small hole using wire EDM	**02**
Experiment-7	Microprocessor controlled pick & place robot	**02**
Experiment-8	Use of Tool Maker's Microscope	**02**
Experiment-9	Comparator and sine bar	**02**
Experiment-10	Surface finish measurement equipment	**02**
Experiment-11	Bore diameter measurement using micrometer and telescopic gauge	**02**
Experiment-12	Use of Autocollimator	**02**
Total No. of Hours		**24**

Learning Outcomes:	Upon completion of this course, students will be able to perform some advanced manufacturing operations and also be able to evaluate the accuracy & tolerance of components produced.
NOTE:	1. Apart from the above practical listed any eight practicals can be conducted by each student. 2. Each student shall be required to perform one experiment in the practical examination. 3. A Teacher shall be assigned 20 students for daily practical work in laboratory. 4. No batch for practical class shall consist of more than 20 students. 5. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 6. Every student shall have to perform minimum eight experiments during the semester. 7. Any Experiment based on syllabus may be added by permission of Head / Dean.

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Course Code: BME-C662

Course Name: Computer Aided Design & Analysis Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	
Objectives:	To develop skill to use software to create 2D and 3D models
Course Coordinator	Dr. Sanjeev Kumar Lambha/ Dr. Jasbir Singh

Module	Course Content	No. of Hours
Experiment-1	Introduction to CAD	**02**
Experiment-2	ACAD – Basics	**02**
Experiment-3	2 - D Figures Using ACAD	**02**
Experiment-4	Isometric Drawings Using ACAD	**02**
Experiment-5	3-D Figures Using ACAD	**02**
Experiment-6	Introduction to CREO 2.0	**02**
Experiment-7	Exercise 1 on CREO 2.0	**02**
Experiment-8	Exercise 2 on CREO 2.0	**02**
Experiment-9	Introduction to Catia	**02**
Experiment-10	Exercise 1 on Catia	**02**
Experiment-11	Exercise 2 on Catia	**02**
Experiment-12	Exercise 3 on Catia	**02**
Total No. of Hours		**24**

Learning Outcomes:	At the end of this course students will be able to: 1. Ability to use the software packers for drafting and modeling. 2. Ability to create 2D and 3D models of Engineering Components.
NOTE:	1. Each student shall be required to perform one experiment in the practical examination. 2. A Teacher shall be assigned 20 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Every student shall have to perform minimum eight experiments during the semester. 6. Any Experiment based on syllabus may be added by permission of Head / Dean.

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Course Code: BME-C670
Course Name: Project-IV (Literature Review)

MM: 50 **Time: 2Hr.** **L T P** **0 0 2**	**Sessional:50** **ESE: 0** **Credit: 1**

Prerequisites:	Fundamental Knowledge of Different Machines.
Objectives:	This course is aimed to provide more weightage 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.
Course Coordinator	Dr. Jasbir Singh/ Dr. Sunil Kumar

* Total 50 marks include 25 marks for report and 25 marks for presentation.

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Program Elective -I (Sixth semester)

Course Code: BME-P621
Course Name: Smart materials and Structures

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Materials Engineering
Objectives:	Structures in the traditional context once simply meant a selection of the dimensions of the load bearing components of a structure. Essentially conventional design and materials science were integrated to obtain a structural design.
Course Coordinator	Dr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	Introduction to smart structure, historical development, characteristics, examples; active vibration damping system, active noise reduction system in automobile, aircraft, other vehicles etc.	**04**
UNIT-2	*Module -2*	Smart materials, their characteristics and applications; electro responsive materials, thermos responsive materials, opto responsive materials, magneto responsive materials.	**08**
UNIT-3	*Module -3*	Optical fiber sensor technology; Interferro meters,Structural Health Monitoring using optical fiber sensors.	**06**
UNIT-4	*Module -4*	Smart structures using piezoelectric materials; vibration damping, energy harvesting, structural health monitoring.	**06**
	Module -5	Smart structures using SMA materials; vibration damping, flapping mechanism,biomedical applications.	**06**
UNIT-5	*Module -6*	Smart structures using ER/MR fluids; vibration damping, smart bearing	**05**
	Module -7	Nanomaterials, characteristics,and their applications as smart systems	**05**
Total No. of Hours			**40**

Learning Outcomes	At the end of this course students are able to knowledge smart characterization and application in material their developing/designing smart structures,

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Srinivasan A. V., McFarland D. M., "*Smart Structures Analysis and Design",* Cambridge University Press, ISBN- 0521659779	2000
2.	Soh C. K., Yang Y., Bhalla S. "*Smart Structures Analysis and Design, Control and Bio-Mechanics",* springer, ISBN- 3642244629	2012
3.	Reece P. L., "*Smart Materials and Structures",* IOP Publishing (United Kingdom), Publisher, ISBN- 0964-1726	2018
4.	M.V. Gandhi, B.D. Thompson., "Smart Materials and Structures" Springer; 1992nd edition.	1992

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Course Code: BME-P622

Course Name: Vibrations and Noise Control

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Strength of Materials and Mathematics.
Objectives:	The students learn the fundamental vibration analysis methods for single degree of freedom systems, two degree of freedom systems and multi degree of freedom systems, Acoustics and Noise control. They can classify various machine vibrations which are important in engineering and sensitivity. They can have the mastery of applying the fundamental concepts of vibration to practical engineering problems. They will be able to solve unknown vibration problems.
Course Coordinator	Dr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Introduction:** Importance and scope of vibrations, terminology and classification, concept of degrees of freedom,harmonic motion, vectorial representation, complex number representation, addition of harmonic motions, beats phenomenon.	**03**
	Module -2	**Vibration of Single degree of freedom system:** Modelling of stiffness and damping (both viscous and coulomb). Estimation of damping by decay plots and half power method. Impulse, transient and forced vibration response of single degree of freedom system. Theory of practice of vibration isolation. Vibration measuring instruments.	**05**
UNIT-2	*Module -3*	**Two Degree of freedom system:** Principle mode of vibration, Mode shapes, Undamped forced vibrations of two degree of freedom systems with harmonic excitation, Vibration absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber. Application to undamped and damped absorbers.	**06**

UNIT-3	*Module -4*	**Critical Speed of Shafts:** Critical speed of a light shaft without damping, critical speed of shafts having multiple discs, secondary critical speed.	**03**
	Module -5	**Multi-Degree of Freedom system (Exact Analysis):** Equation of motion, The matrix method, Eigen values and Eigen vectors, Methods of influence coefficients and Maxwell's reciprocal	**06**
		theorem. Torsional vibration of multi rotor systems, vibration of geared systems.	
UNIT-4	*Module -6*	**Multi-Degree of Freedom system (Approximate methods):** Multi-degree freedom systems. Modal analysis. Rayleigh's and Dunkerley's method. Holzer's and Myklestad-Prohl transfer matrix methods.	**05**
	Module -7	**Continuous Systems:** Governing wave equation and Euler Bernoulli equation. Free and forced vibrations including modal analysis.	**04**
UNIT-5	*Module -8*	**Acoustics and Noise Control:** Acoustic wave equation, Acoustic energy and sound intensity. Propagation of sound, Concept of Acoustic impedance. Sound power transmission, Transmission loss. Human Response and ratings, Various Measures of sound. Weighting filters, loudness, Indices of loudness. Acoustic radiation from spherical source and piston source. Acoustic sensors. Measuring Techniques and Instruments. types of measurement environment and uses. Industrial noise control, Noise in machinery.	**08**
Total No. of Hours			**40**

Learning Outcome:	At the end of the course students are able to: 1. Understand the concept of degree of freedom, natural frequency of single degree of freedom system, frequency response, decay in response curve, transmissibility (vibration isolation) and solve actual vibration problems. 2. Understand coupled natural frequencies and natural modes of two degrees of freedom systems, and explain the concept of modal analysis. 3. Understand the concept of acoustics, sound propagation, Noise in industries, Noise in machineries etc. and are able to apply these concepts onto the practical applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Meirovitch Leonard, "***Elements of Vibration Analysis***", .McGraw Hill, ISBN: 0-07-118174-1.	2001
2.	Dukipatti R. V. and Srinivas J., "***Textbook of Mechanical Vibrations***", 2nd Ed., PHI Learning Pvt. Ltd., ISBN-978-81-2034524-9.	2012
3.	Thomson W.T. , "***Theory of Vibration with Applications***", 5th Ed., Pearson, ISBN-978- 0136510680.	1997
4.	Ambekar A. G. "***Mechanical Vibrations and Noise Engineering***", PHI, *ISBN-81-203- 2900-7*.	2006

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Course Code: BME-P626

Course Name: Computational Fluid Dynamics

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fluid Mechanics & Machines, Heat Transfer
Objectives:	To provide elementary knowledge about CFD (Computational Fluid Dynamics)
Course Coordinator	Mr.Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Governing Differential Equations and Finite Difference Method- Classification of PDEs- Initial and Boundary conditions - Initial and Boundary value problems - Finite difference method- Central, Forward, Backward difference for a uniform grid – Central difference expressions for a non-uniform grid - Numerical error - Accuracy of solution – Grid independence test.	**08**
UNIT-2	*Module-2*	Conduction Heat Transfer- Applications of Heat conduction - Steady and Unsteady conductions - One dimensional steady state problems - Two dimensional steady state problems - Three dimensional steady state problems - Transient one dimensional problems.	**08**
UNIT-3	*Module-3*	Convection Heat Transfer- Introduction - Steady one dimensional Convection-Diffusion - Unsteady one. Dimensional Convection – Diffusion – Unsteady two dimensional Convection - Diffusion.	**08**
UNIT-4	*Module-4*	Incompressible Fluid Flow- Introduction - Governing equations - Difficulties in solving Navier-Stokes equation - Stream function - Vorticity method - In viscid flow (steady) - Determination of pressure for viscous flow.	**08**

UNIT-5	*Module-5*	Applications of Computational Fluid Dynamics- Computer graphics in CFD - Future of CFD - Enhancing the design process - understanding - Applications - Automobile, Engine, Industrial, Civil, Environmental.	**08**
Total No. of Hours			**40**
Learning Outcomes:	After the completion of course student will learn about the basic and governing of heat flow in conduction and convection mode. Student will also learn the application of CFD in different areas.		

Suggested books:

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	Muralidhar K., and Sundararajan T., "***Computational Fluid flow and Heat Transfer***",Narosa Publishing House, ISBN- 978-81-7319-522-8	2014
2.	Ghoshdasdidar P. S., "***Computer simulation of flow and heat transfer",*** Tata McGraw– Hill, New Delhi, ISBN-9780074631508	1998
3.	Anderson D. A., Tannehill J. L, and Pletcher R. H., "***Computational fluid mechanics and Heat Transfer",*** Hemisphere Publishing Corporation, ISBN-978-1591690375	2021
4.	John David Anderson, "***Computational Fluid Dynamics: The Basics withApplications***", McGraw Hill, New York, ISBN-9780071132107	2010

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Course Code: BME-P627

Course Name: Environmental Pollution and Abatement

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**
Prerequisites:	NIL
Objectives:	1. Impart knowledge on fundamental aspects of air pollution & control, noise pollution, and solid waste management. 2. Provide basic knowledge on sustainable development. 3. Introduces some basics of sanitation methods essential for protection of community health.
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Historical perspectives, Effects of Pollutants on Human Health- Human respiratory system	**06**
UNIT-2	*Module-2*	Classification and sources of pollutants-CO, CO2, O2, N2 cycles – sources and sinks.	**05**
UNIT-3	*Module-3*	Reactions of pollutants in the Atmosphere-Smoke, smog, fog, acid rain and ozone layer. Global warming and its effects. Regulatory laws and standards. Atmospheric diffusion of pollutants, transport, transformation and deposition. Atmospheric lapse rate, inversions and heat balance.	**10**
UNIT-4	*Module-4*	Air sampling and pollutant measurement methods-Principles and instruments. Ambient air quality and emission standards.	**09**
UNIT-5	*Module-5*	Control principles- Removal of gaseous pollutants by absorption, adsorption, chemical reaction and other methods. Selective catalytic reduction of NOX. Particulate emission control; settling chambers, cyclone separation, wet collectors, fabric filters and electrostatic precipitators. Clean coal technology and shifted emphasis on non-carbon sources of energy.	**10**
Total No. of Hours			**40**

Learning Outcomes:	1. Quantify and analyze the pollution load. 2. Analyze/design of suitable treatment for wastewater 3. Model the atmospheric dispersion of air pollutants. 4. Selection and design of air pollution control devices. 5. Analyze the characteristics of solid waste and its handling & management

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Schnelle K. B., & Brown C. A. "***Air pollution control technology handbook***", CRC Press, ISBN- 9780429122354	2001
2.	Peavy H. S., Rowe D. R. & Tchobanoglous G. "***Environmental engineering***", 4th Edition, McGraw-Hill, ISBN- **978-9351340263**	2017
3.	Vesilind P. A., Morgan S. M., & Heine L. G "***Introduction to Environmental Engineering***", 1st Edition, Cengage Learning, ISBN- 978-0495295853	2010
4.	Ruth F. Weiner and Robin Matthews, ***"Environmental Engineering",*** 4th Edition, Elsevier,ISBN- 9780750672948	2003
5.	J.G. Henry and G.W. Heinke , ***"Environmental Science and Engineering",*** Pearson Education.	1996

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Course Code: BME-P628

Course Name: Integrated Design and Manufacturing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Material Science, Manufacturing technology
Objectives:	Those who can work effectively in an integrated product design and manufacturing role, as well as, providing an opportunity to develop technical and managerial skills for a competitive global market can go for the course. Upgrade the skills and knowledge of students seeking career opportunities at a managerial level in a broad range of design, manufacturing, consulting and service industries also can go for it.
Course Coordinator	Dr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	**Module**	**Course Content**	**No. of Hours**
UNIT-1	*Module -1*	Life cycle of Mechanical Equipment Design	**8**
UNIT-2	*Module -2*	Requirements of life cycle personnel likcustomer, management, marketing, manufacturing, transportation, etc.	**8**
UNIT-3	*Module -3*	Role of analysis, creativity/ innovation, decision making and information processing in engineering design and problem solving.	**8**
UNIT-4	*Module -4*	Practice in engineering problem solving and designing. DFMA to meet requirements of design and manufacturing.	**8**
UNIT-5	*Module -5*	Principles of Material selection. Case studies and practice on Material selection and Design for manufacture and assembly using first principles, programs/ packages.	**8**
Total No. of Hours			**40**

Learning Outcome:	There are tremendous advantages of integrating your design and manufacturing processes and teams. In doing so, you're increasing quality output, saving time and money on data translation and personnel training, and you're allowing your teams to work concurrently.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Asimov M., "***Introduction to design",*** Prentice-Hall, ISBN- 978-0134806167	1962
2.	Pugh S., "***Total design: integrated methods for successful product engineering",*** Addison- Wesley Pub., ISBN- 978-0201416398	1991
3.		
4.	Bralla J. G., "***Design for manufacturability handbook***", McGraw-Hill, ISBN-0852969767	1998
5.	Fiksel J., & Fiksel J. R., "***Design for environment: a guide to sustainable product development***", McGraw-Hill, ISBN- 0071605568	2009
6.	Anderson D. M., "***Design for manufacturability & concurrent engineering: how to design for low cost, design in high quality, design for lean manufacture, and design quickly for fast production***", CIM Press, ISBN- 1482204924	2014
7.	Ashby M. F., "***Materials selection in mechanical design***" Elsevier Butterworth-Heinemann, ISBN- 9380931727	2010
8.	NPTEL courses: *http://nptel.iitm.ac.in/courses.php* - web and video resources on *Design for Manufacturing.*	

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Course Code: BME-P629

Course Name: Advanced Engineering Thermodynamics

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fundamental Knowledge of Basic Thermodynamics Engineering.
Objectives:	This course deals with the advance level of Thermodynamics. In this student will learn about entropy generation. Reactive system and its application in Thermodynamics.
Course Coordinator	Dr. Sunil Kumar/ Dr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	**Module**	**Course Content**	**No. of Hours**
UNIT-1	*Module -1*	**Review of laws of thermodynamics:** Energy concepts for closed and open systems.	**06**
UNIT-2	*Module -2*	**Entropy considerations:** Minimization of entropy generation principle and thermodynamic optimization.	**08**
UNIT-3	*Module -3*	**Energy:** Energy analysis of thermal systems and plants, Thermo-economic applications.	**08**
UNIT-4	*Module -4*	**Phase transition:** Equations of state, Multi- component and multi-phase system, Reactive systems.	**08**
UNIT-5	*Module -5*	Kinetic theory of gases, Distribution of molecular velocities and energy, transport properties of gases	**06**
	Module -6	Principles of irreversible thermodynamics and applications.	**04**
Total No. of Hours			**40**
Learning Outcomes:	After the completion of this course, student will have a good understanding of entropy, entropy generation systems, reactive system, kinetic theory of gases and applications.		

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bejan A., "***Advanced engineering thermodynamics", 3rd*** Ed, John Wiley & Sons, ISBN-978-0-471-67763-5	2006
2.	Bejan A., "***Entropy generation minimization: the method of thermodynamic optimization of finite-size systems and finite time processes",*** 1st Ed, CRC Press, ISBN-9781498782920	1995
3.	Annamalai K. & Puri I.K., "***Advanced thermodynamics engineering",*** 2nd Ed, CRC Press, ISBN- 9781498768412	2011
4.	Wark K., "***Advanced thermodynamics for engineers",*** 1st Ed, Mc-Graw Hill, ISBN-9780070682924	1994
5.	Winterbone D. E., "***Advanced thermodynamics for engineers",2nd*** Ed, Arnold, ISBN- 9780080999838	2015

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Course Code: BME-P630

Course Name: Vehicle Technology

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Electrical Machines, Control system
Objectives:	
Course Coordinator	Mr. Kapil Dev Sharma/ Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction to I.C. Engines**: Engine classification, Air standard cycles, Otto, Diesel, Stirling, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines. SI Engines: Carburetion, Mixture requirements, Carburetor types Theory of carburetor, MPFI. Combustion in SI engine, CI Engine: Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings	**8**
UNIT-2	*Module-2*	**INTRODUCTION TO ELECTRIC VEHICLES:** History of electric vehicles, social and environmental importance of electric vehicles, impact of modern drive-trains on energy supplies. Comparison by efficiency of Conventional, Hybrid, Electric and Fuel cell Vehicles.	**8**

UNIT-3	*Module-3*	**ELECTRIC DRIVE-TRAINS**: Basic concept of electric traction, Introduction to various electric drive-train topologies, Power flow control in electric drive-train topologies.	**6**
UNIT-4	*Module-4*	Introduction-background, Hydrogen use as a motor fuel. Hydrogen storage on Vehicle , reforming as liquid fuels, Electrolysis of water, Properties of Hydrogen- Gaseous Hydrogen ,Liquid Hydogen, Comparison of Hydrogen to others motor fuels.	**9**
UNIT-5	*Module-5*	Introduction To Connected, Automated And Intelligent Cars Introduction to Connected, automated and Intelligent cars- Automotive Electronics Overview, Advanced Driver Assistance Electronic Systems, Connected Car Technology- Connectivity Fundamentals, Navigation and Other Applications, Connected and Autonomous Vehicle Technology Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory.	**9**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Understand technology and advancements applied in and connected, Automated and intelligent Cars. 2. Understand the advanced technology based on Hydrogen gas, 3. Apply knowledge of sensor and wireless technology to

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, "Autonomous Vehicles Technologies, Regulations, and Societal Impacts", Elsevier Publications,	2021.
2.	Dietmar P.F. Möller, Roland E. Haas, Guide to Automotive Connectivity and Cybersecurity: Trends, Technologies	2019
3.	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2 nd Edition,	2017
4.	Hanky Sjafrie, "Introduction to Self-Driving Vehicle Technology", 1st Edition, Published by Chapman and Hall/CRC	2019

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Course Code: BME-P631

Course Name: Production & Operation Management

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	1. To provide knowledge on machines and related tools for manufacturing various components. 2. To understand the relationship between process and system in manufacturing domain. 3. To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Introduction:** Scope of production management. Production system and resources (machines, tooling, etc.); Types of production (batch, flow and unit), Roles of line supervisors and production managers.	**8**
UNIT-2	*Module -2*	**Project Management:** Project life cycle: concept phase (RFQ, Quotations, Proposals), Project initiations, DPR preparation (project value, business case development and feasibility study); Project planning (obtaining resources, acquiring financing and procuring required materials); Project team, producing quality outputs, handling risk, acceptance criteria; Project execution (allocation of resources, scheduling, building deliverables); Project Monitoring and control: Project networks, progress review (physical and financial), CPM and PERT, critical path, re-scheduling; Project closure: acceptance of project deliverable; Analytics: Performance, capability aggregation, cost benefit analysis, variability analysis, Output-outcome analysis, project documentation, best practices, and depository.	8

UNIT-3	*Module -3*	**Production Planning and Control:** Production planning, Process planning, Resource planning, demand-utility mapping (production capability index, forecasting models, aggregate production planning, materials requirement planning); Inventory Management: Economic order Quantity, discount models, stochastic inventory models, practical inventory control models, JIT; Supply chain and management.	8
UNIT-4	*Module -4*	**Factory Management:** Factory layout: line balancing, material flow and handling, Lean and green manufacturing, Human resource management, Training need analysis, Advantage and opportunities for Digitalization, Advanced factory systems: TQM; Important acts, regularities and safety norms, Reliability assessment of processes, Block chain, Energy management, Efficiency & throughput, Overall equipment effectiveness. Process capability, lean manufacturing.	8
UNIT-5	*Module -5*	**Operation Management:** Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment; Simple queuing theory models; Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model.	**8**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. To provide knowledge on production management techniques that develop and establish 2. relationship between market demand and production capability. 3. To understand the operation management: Resource planning and their utility 4. To understand the scientific approach and tools and techniques that assure market 5. competitiveness by ensuring the quality, cost and time

Suggested books:

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	L.J. Krajewski and L.P Ritzmen, Operations Management: Strategy and Analysis, Pearson.	2010
2.	R.B. Chase, F.R. Jacobs and N.J. Aquilano, Operations Management for Competitive Advantage, Tata McGraw Hill.	2011

3.	W. J. Hopp and M. L. Spearman, Factory Physics: Foundations of Manufacturing Management, McGraw Hill International Edition.	2008
4.	Mahadevan. B., Operations Management: Theory and Practice, Pearson.	2015
5.	Taha H. A., Operations Research, 6th Edition, PHI India.	2003
6.	M.P. Poonia, Total Quality Management, Khanna Publishing House.	2022

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_mg06/preview

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Course Code: BME-P632

Course Name: Mechatronics Robotics & Control

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	1. Model and analyze mechatronic systems for an engineering application 2. Identify sensors, transducers and actuators to monitor and control a process or product. 3. Develop PLC programs for an engineering application. 4. Evaluate the performance of mechatronic systems.
Course Coordinator	Mr. Kapil Dev Sharma/ Dr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Electro-mechanical systems; Typical applications; Examples – automobiles, home appliances, medical instruments, etc.	**8**
UNIT-2	*Module-2*	**Sensors:** Transduction principles; Sensitivity, accuracy, range, resolution, noise sources; Sensors for common engineering measurements – proximity, force, velocity, temperature, etc.; Signal processing and conditioning; Selection of sensors.	**4**
	Module-3	**Actuators:** Pneumatic and hydraulic actuators; Electric motors including DC, AC, BLDC, servo and stepper motors; Solenoids and relays; Active materials – piezoelectric and shape memory alloys.	**4**
UNIT-3	*Module-4*	**Machine Controls:** Microprocessors and their architecture; Memory and peripheral interfacing; Programming; Microcontrollers; Programmable Logic Controllers; PLC principle and operation; Analog and digital input/output modules; Memory module; Timers, internal relays, counters and data handling; Industrial automation systems; Basic PLC programming; Industry kits (Arduino, Raspberry Pi, etc.).	**8**

UNIT-4	*Module-5*	**Robotics:** Robot configurations: serial and parallel; Denavit–Hartenberg parameters; Manipulators kinematics; Rotation matrix, Homogenous transformation matrix; Direct and inverse Kinematics for robot position and orientation; Workspace estimation and path planning; Robot vision; Motion tracking; Robot programming and control; Industrial robots - Pick and place robots, sorting, assembly, welding, inspection, etc.	**8**
UNIT-5	*Module-6*	**Control Theory and Systems:** Basic control concepts; Feedback; Open and closed loop control; Concept of block diagrams; P, PI and PID controllers; Tuning the gain of controllers; System models, transfer functions, system response, frequency response; Root Locus method and Bode plots.	**6**
	Module-7	**Computational Tools:** Demonstration and projects using simulation software (e.g., Matlab, Scilab, ROBODK) for control systems and robotics.	2
Total no hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Ability to recognize and analyze electro-mechanical systems in daily lives. 2. Understand the role of sensors, actuators, and controls in mechatronic systems. 3. Understand the basic theory of robot kinematics. 4. Familiarity with control theory and controller design. 5. Understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	W. Bolton, "Mechatronics," Addison Wesley Longman.	2010
2.	J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley.	1999
3.	G.K. McMillan, "Process/Industrial Instruments and Controls Handbook," McGraw-Hill.	1999
4.	S. Mukherjee, "Essentials of Robotics Process Automation", Khanna Book Publishing.	2021

Online Resources:

1. https://nptel.ac.in/courses/107/106/107106090/
3. https://nptel.ac.in/courses/112/101/112101098/
4. https://nptel.ac.in/courses/112/107/112107289/
5. https://nptel.ac.in/courses/112/104/112104298/

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Open Elective -I (Sixth semester)

Course Code: BME-O631

Course Name: Numerical Analysis.

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Mathematics
Objectives:	Provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration. To improve the student's skills in numerical methods by using the numerical analysis software and computer facilities.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Errors and Roots of Equations**: Absolute, relative,round-off andtruncationerrors.Significant digits.Algebraic and Transcendental Equations	**03**
	Module -2	Numerical solution, Method of bisection, Newton- Raphson method, Directiterative method,convergence.	**05**
UNIT-2	*Module -3*	**Linear Simultaneous Algebric Equations** Method of Gauss elemination, LU - decomposition Jacobi's and Gauss- Seidal methods, Largest eigen value and corresponding eigen vector (Powersmethod)..	**08**
UNIT-3	*Module -4*	**Interpolation:** Finite difference operators, Greogory- Newton, Stirling, Bessel andLagrange's	**03**
	Module -5	Formula. Error interpolation. Divid differees.	**06**
UNIT-4	*Module -6*	**Numerical Differentiation and Integration**: Differentiation, Newton-Cotes formula of Inegration, Gaussian Quadrature formula.	**05**

	Module -7	Extension of Trapezodial and Simpson's rules to multiple integration.	**04**
UNIT-5	*Module -8*	**Ordinary Differential Equations**: Picard, Taylor, Eulers, Runge-Kutta, Adams-Bash forth and Milne's method. System of ordinary differential equations, Partial Differential Equations: Numerical solutions of Laplace and Poisson equations by finite difference method.	**06**
Total No. of Hours			**40**
Learning Outcomes:	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. Analyse and evaluate the accuracy ofcommon numerical methods.		

Suggested books:

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	Grewal, B.S., Numerical Methods in Engineering & Sciences, Khanna, New Delhi, ISBN- 10-817409248X	2013
2.	Sastry B., Introductory Method of Numerical Analysis, PHI, ISBN-10-9788120345928	2012
3.	Gerald C.F. (5/e), Applied Numerical Analysis, Addison Wesley, 1994. ISBN-10-8131717402	2007
4.	Jain M.K, Iyengar S.R.K., Jain R.K., Numerical Methods for scientific & Engineering Computation,Wiley, 1987. ISBN 0-85226-434-8	1987

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Course Code: BME-O632

Course Name: Industrial Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Work and method Study of Industrial Engineering
Objectives:	1. Basic understanding of Industrial process like type of industry, optimization of production process, reduction of inventory, organization structure and modern manufacturing practices like JIT . 2. To apply knowledge of mathematics, science, and engineering for process mapping and productivity enhancement
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Productivity**: Introduction, definition, measurement, productivity index, ways to improve productivity, Types of Production System.	**03**
	Module -2	**Work Study:** Meaning and benefits of work-study, time & motion study. Micro motion study P.M.T.S. man machine Diagram flow chart. Motion economy.	**05**
UNIT-2	*Module -3*	**Method Study:** Objectives and scope of method study, recording techniques, micro motion study and memo-motion study, fundamental motion and therbligs, principal of motion economy, critical examination. **Work Measurement**: Objectives of work measurement, work measurement techniques, procedure. Work sampling, determining the sample size, determining time standards by work sampling. Absolute error or desired absolute accuracy.	**08**

UNIT-3	*Module -4*	**Plant Layout and Materials Handling:** Plant location, type of layout, principles of facility layout principles of material handling, Material Handling equipment's	**03**
	Module -5	**Production Planning and Control:** Objectives, Forecasting, product design and development functions, steps in PPC. Planning rating, scheduling, Dispatching & follow-up, Effectiveness of PPC, Introduction of JIT. Elements involved in JIT, Advantages & Disadvantages of Just-In-Time Systems	**06**
UNIT-4	*Module -6*	**Inventory Control**: Inventory, Inventory control techniques; Inventory cost analysis and control; Economic order quantity and safety stock.	**05**
	Module -7	Introduction to MRP, supply chain Management .	**04**
UNIT-5	*Module -8*	**Industrial Ownership**: Proprietorship, partnership, Joint stock & co-operative stores. **Manpower Planning**: Resources, Human relationship. **Organization:** Principles of organization, Development of Organizational charts like line, staff, line and staff & Functional types. **Job Evaluation & Merit Rating:** Job analysis, Job description job simplification and job evaluation methods & description, merit rating, wage incentive plans..	**06**
Total No. of Hours			**40**

Learning Outcome:	At the end of the course students are able to: 1. An ability to identify, formulate, and solve complex problems related to productivity. 2. An ability to apply engineering design to produce solutions that meet specified needs 3. with consideration of public health, safety, and welfare, as well as global, cultural, social, 4. Environmental, and economic factors 5. An ability to function effectively on a team whose members together provide leadership for development of an organization. 6. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies..

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	H.Koontz & C.O. Donnel , Principles of management. An analysis of management functions-. Tata McGrow-Hall Co	2001
2.	J Moore ,Manufacturing Management, Prentice Hall Englewoon cliffs: New Jersey	2006
3.	Buffam E.S,Modern production operations Management, Wiley eastern.	2003
4.	O.P. Khanna.,Industrial Engg. & Management, ISBN-10-818992835X	2008

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Course Code: BME-O633

Course Name: Operations Research

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic mathematics
Objectives:	1. Student can learn mathematical modelling to real word problem using LPP, Simplex method to find optimal solution. 2. Dual Simplex method, Integer programming problems and Dynamic programming problems and their solutions, Transportation, Assignment and Game theory. Queuing theory, their types and solutions.
Course Coordinator	Dr.Lokesh Joshi

Note	The question paper shall consist of two sections (Section-A and Section-B). Section- A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

Unit	Module	**Course Content**	**No. of hours**
Unit -1	Module-1	Li near Programmi ng : introduction, Construction of LP Model, Graphical of Solution LP.Simplex Method , Introduction, Standard LP Form and its basic Solutions, Simplex Algorithm,. Artificial Starting Solution, Special cases in Simplex Method, Applications.	**9**
Unit-2	Module-2	Duality: Introduction, Definition ofDual Problems, Relationship between the Optimal Primal and Dual Solutions, Economic interpretation of Duality, Dual Simplex Method. Primal Dual Computation	**4**

Unit -3	Modul e-3	Integer Programming : Methods of Integer Programming, Cutting-Plane Method :Fractional (Pure Integer) Method, Mixed-Cut method, Branch and Bound Technique Deterministic DynamicProgramming: introduction, Recursive Nature of Computing, forward and Backward Recursion , Applications of Dynamic Programming m Shortest Route Problem. Cargo Loading Problem,Work Force SizeModel	**9**
Unit-4	Module-4	Transportation and Assignment Model : Dcfinition of Transporation Model, Non Traditional Transportation Model, Transportation Algorithms, Assignments Model, Game Theory :Minimax-Maximin criterion, Pure strategies,Mixed straicgies and Expected Payoff, Concept of Dominance, Graphical Solution of m x 2 and 2 x n Games Solution by Linear Programming method	**9**
Unit-5	Module-5	Queuing Theory: Definition of Queuing System, Characteristics of Queuing Models.. Notation, Transient and Steady State of Queuing System, Birth-Death process, Pure birth & Pure Death processes, (M/M/1):(FIFO), (M/M/s):(FIFO'), (M/M/1) (FIFO) Models, Their Characteristics, State Transition Diagrams	**9**
Total No. of Hours			**40**

Learning Outcomes	After completion of course student will be: 1. Analyse any real life system with limited constraints and depict it in a model form. 2. Convert the problem in to a mathematical model solve it manually as well as using software. 3. Develop a repost that describe the model analyse the results and propose recommendations in decision making process in real life problem. 4. Understand variety of problems such as assignment, transportation, travelling salesman etc. and their application in real life systems. 5. Understand different queuing situations in real life and find their optimal solution using different queuing models.

Suggested books:

S. No.	Name of Authors/Books /Publisher	Year of publication
1.	Kanti Swarup,D.S.Hira,Prem Kumar Gupta	1992
2.	Frederick S. Hiller,Gerald J. Lieberman	1990
3.	S.D.Sharma	2002
4.	Hamdy A. Taha	1971

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Course Code: BME-O634

Course Name: Concurrent Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Design of Product and Quality.
Objectives:	Concurrent Engineering aims to reduce the number of redesigns, especially those resulting from post-design input from support groups. Concurrent Engineering provides benefits suchas reduced product development time, reduced design rework, reduced product development cost and improved communications.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Introduction:** Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs.	**03**
	Module -2	Support for CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.	**05**
UNIT-2	*Module -3*	**Design Product for Customer:** Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent Engineering Design. Compatibility approach, Compatibility index, implementation of the Compatibility model integrating the compatibility Concerns	**08**

UNIT-3	*Module -4*	**Design for Manufacture (DFM):** Introduction, role of DFM is CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms	**03**
	Module -5	Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assimilability.	**06**
UNIT-4	*Module -6*	**Quality by Design:** Quality engineering & methodology for robust product design, parameter.	**05**
	Module -7	Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.	**04**
UNIT-5	*Module-8*	**Design for X-ability:** Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.	**06**
Total No. of Hours			**40**

Learning Outcomes:	Concurrent Engineering is the practice of receiving product manufacturability input throughout the product development process. By considering manufacturability throughout the process, manufacturing issues can be identified and resolved as they surface, resulting in a better overall project outcome for the client.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of publication
1.	Concurrent Engineering Kusiak John Wiley. ISBN: 978-0-471-55492-9	1992
2.	Concurrent Engineering Menon Chapman & hall, ISBN-978- 0412581304	1994

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Course Code: BME-O635

Course Name: Quality Management

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Industrial designing of product.
Objectives:	1. To Test kinematic and Geometric accuracy of Machine Tool Alignment, Location, Orientation errors between Spindle, Slides, Tool/ work Holders 2. Certification, Maintenance tasks, History.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	Principles of measurement, Concept of Tolerance & Fit, Standards of measurements; Concepts of interchangeability, Taylor's principles	**04**
	Module -2	Design of limit gauge; Selective assembly. Off-line& On-line Inspection,	**04**
UNIT-2	*Module -3*	Mechanical, pneumatic, electrical, electronic and optical measuring systems for in-process and post- process, product feature inspection; Measurement techniques of different machine elements e.g gears, threads, bearings, cutting tools etc., machine tool metrology; Principles of light wave interferometry and interferometers; Ultrasonic gauging.	**04**
UNIT-3	*Module -4*	Surface quality features measurement and analysis. Quality and reliability;	**08**
UNIT-4	*Module -5*	Basic principles of statistical quality control; General theory of control charts for variable and attributes.	**10**
UNIT-5	*Module -6*	Concept of acceptance sampling; Computer applications in inspection and quality control, ISO9000 requirements.	**10**

Total No. of Hours	40

Learning Outcme:	1. On completing the course, students should be able to understand the Inspection and control of product and able to quality maintain the quality. 2. To Test kinematic and Geometric accuracy of Machine Tool • Alignment, Location, Orientation errors between Spindle, Slides, Tool/ work Holders • Certification, Maintenance tasks.

Suggested books

S. No.	Name of Authors /Books /Publisher	Year of
1.	Walter A. Shewhart Economic Control of Quality of Manufactured Product ISBN-10-1614278113	2015
2.	Ellis R. Ott, Edward G. Schilling, Dean V. Neubauer ,Process Quality Control: Troubleshooting and Interpretation of Data, Fourth Edition, ISBN-10-0873896556	2005
3.	Walter A. Shewhart Economic Control of Quality of Manufactured Product ISBN-10-1614278113	2015

Course Code: BME-C711

Course Name: Refrigeration & Air Conditioning

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fundamental Knowledge of Thermodynamics.
Objectives:	● To familiarize with the terminology associated with refrigeration systems and air conditioning. ● To understand basic refrigeration processes. ● To understand the basics of psychrometry and practice of applied psychometrics. ● To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components.
Course Coordinator	Mr. Kapil Dev Sharma

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Refrigeration:** Introduction to refrigeration system, Methods of refrigeration, Carnot Refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P.	**02**
	Module -2	**Air Refrigeration Cycle:** Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).	**06**

UNIT-2	*Module -3*	**Vapour Compression System:** Single stage system, Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Advanced vapour compression cycles, Different configuration of multistage system, Cascade system	**08**
UNIT-3	*Module-4*	**Vapour Absorption System:** Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison.	**06**
	Module-5	**Refrigerants:** Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. Ozone depletion and global warming issues	**02**
UNIT-4	*Module-6*	**Air Conditioning:** Introduction to air conditioning, Psychometric properties, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).	**08**

UNIT-5	*Module-7*	**Refrigeration Equipment & Application:** Elementary knowledge of refrigeration & air conditioning equipment's e.g. compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning	**08**
Total No. of Hours			**40**

Learning Outcomes:	A student who has done the course will have a good understanding of ● The working principles of Refrigeration system, different types of air conditioning systems and their working, different types of refrigerants and air-conditioning systems.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Manohar Prasad, ***"Refrigeration and Air conditioning",*** 3rd edition, New Age International (P) Ltd. Publication ISBN- 978-8122436945	2020
2.	C P Arora***, "Refrigeration and Air conditioning",*** 3rd edition, McGraw Hill Education, ISBN- 978-9351340164	2017
3.	W. F. Stoecker, J. W. Jones, ***"Refrigeration and Air conditioning",*** McGraw Hill India, Publisher, ISBN- 9789332902954	2014
4.	P.L. Ballaney***, "Refrigeration and Air conditioning",***16th edition, Khanna Publishers, ISBN- 978-8174091369	1972

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Course Code: BME-C712

Course Name: Maintenance and Reliability Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	English language
Objectives:	• To ensure that equipment and infrastructure are always in good condition. • To carry out prompt emergency repair of equipment and infrastructure so as to secure the best possible availability for production. • To ensure the operation of equipment for production and for the distribution of energy and fluids.
Course Coordinator	Mr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Introduction:** Introduction, operating life cycle, reliability, Failure analysis, failure rate curve, elements in series, parallel, logic diagrams, improving reliability, maintainability, availability, reliability and maintainability.	**08**
UNIT-2	*Module -2*	**Maintenance Strategies**: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, and zero break down.	**08**
UNIT-3	*Module -3*	Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure.	**08**
UNIT-4	*Module -4*	Break down maintenance planning, assignment model, minimum cost service rate.	**08**
UNIT-5	*Module -5*	Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.	**08**
Total No. of Hours			**40**

Learning Outcomes:	● Understand the maintenance function and its objectives and know how to prepare report about the maintenance function. ● Gain the necessary knowledge about the types of maintenance and know how to use them when design maintenance systems.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Nauhria & Prakash, ***Management of systems***, Wheeler publishing, ISBN-9788185814520	1998
2.	V. Venkataraman , ***Maintenance engineering and management,*** *Prentice Hall India Learning Private Limited,* ISBN- 978-8120331303	2007
3	H P Garg, ***Industrial Maintenance,*** S. Chand Publishing, ISBN- 9788121901680	2010
4.	R.C Mishra, ***Maintenance Engineering and Management,*** Prentice Hall India Learning Private Limited; 2nd edition, ISBN- 978-8120345737	2012

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Course Code: BME-C761

Course Name: Refrigeration & Air Conditioning Lab

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**

Prerequisites:	Fundamental Knowledge of Refrigeration cycle and air conditioning equipment.
Objectives:	● To understand the practical knowledge of vapour compression cycle. ● To understand the practical knowledge of air conditioning test rig. ● To understand the practical knowledge of ice plant test rig. ● To understand the practical knowledge of different devices used in industry.
Course Coordinator	Mr. Kapil Dev Sharma

Module	Course Content	No. of Hours
Module -1	Experiment on refrigeration test rig and calculation of various performance parameters	**02**
Module -2	Experiment on air-conditioning test rig & calculation of various performance parameters.	**02**
Module -3	Experiment on Ice-plant test rig & calculation of various performance parameters.	**02**
Module -4	To study different types of expansion devices used in refrigeration system.	**02**
Module -5	To study different types of evaporators used in refrigeration systems.	**02**
Module -6	To study basic components of air-conditioning system.	**02**
Module -7	To study air washer system and processes.	**02**
Module -8	To study the window air conditioner	**02**
Total No. of Hours		**16**

Learning Outcomes:	At the end of this course students will be able to: Demonstrate the fundamental principles of vapour compression cycle used in refrigeration and air conditioning cycle. Learn the importance of various important components of refrigeration and air conditioning system. Represent the various processes of the vapour compression cycle of psychometric chart. Operate and maintain the refrigeration and air conditioning system.

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Course Code: BME-C770

Course Name: Project-V (Design & Analysis)

MM: 200 **Time: 2 Hr.** **L T P** **0 0 8**	**Sessional: 60** **ESE: 140** **Credit: 5**

Prerequisites:	Fundamental Knowledge of Different Machines.
Objectives:	This course is aimed to provide more weightage 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.
Course Coordinator	Dr Jasbir Singh

Note: Each student shall be assigned a Minor Project by Departmental committee. The student is required to perform his project work under the supervision of the supervisor(s). There shall be a presentation on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student is required to submit his project report along with a research paper in the form of Dissertation 15 days before the end of VII semester. The student is required to submit three copies of the project work with a certificate from the supervisor(s) that the work is an authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination. Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination. There shall be a seminar on the project work of the student to be evaluated by the Departmental committee chaired by H.O.D.

COURSE OUTCOME:

- Students will get knowledge of problem identification and use their skills for teambuilding and project development.
- Develop a solution for any real world problem.
- Students will get equipped with knowledge of latest/upcoming problems and solutions.
- Students will also be able to improve skills for project planning, implementation and communication.

TEXTBOOKS:

1. Ford, Neal, Matthew McCullough and Nathaniel Schutta, Presentation patterns: Techniques for crafting better presentations (1 ed.), Addison- Wesley, 2012. ISBN 978- 0321820808.

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Course Code: BME-C870

Course Name: Project-V (Prototype & Testing)

MM: 400 **Time: 2 Hr.** **L T P** **0 0 16**	**Sessional: 120** **ESE: 280** **Credit: 8**

Prerequisites:	
Objectives:	It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.
Course Coordinator	Dr. Jasbir Singh

Note: Each student shall be assigned a Minor Project by Departmental committee. The student is required to perform his project work under the supervision of the supervisor(s). There shall be a presentation on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student is required to submit his project report along with a research paper in the form of Dissertation 15 days before the end of VII semester. The student is required to submit three copies of the project work with a certificate from the supervisor(s) that the work is an authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination. Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination. There shall be a seminar on the project work of the student to be evaluated by the Departmental committee chaired by H.O.D.

COURSE OUTCOME:

- Students will get knowledge of problem identification and use their skills for teambuilding and project development.
- Develop a solution for any real world problem.
- Students will get equipped with knowledge of latest/upcoming problems and solutions.
- Students will also be able to improve skills for project planning, implementation and communication.

TEXTBOOKS:

2. Ford, Neal, Matthew McCullough and Nathaniel Schutta, Presentation patterns: Techniques for crafting better presentations (1 ed.), Addison- Wesley, 2012. ISBN 978- 0321820808.

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Program Elective – II/III (Seventh/ Eighth Semester)

Course Code: BME-P722/ BME-P822

Course Name: Advanced Machining Processes

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Conventional Machining Processes.
Objectives:	● To identify the classification of unconventional machining processes. ● To understand the principle, mechanism of metal removal of various unconventional machining processes. ● To understand the applications of different processes. ● To study the various process parameters and their effect on the component machined on various unconventional machining processes
Course Coordinator	Mr. Rishi Kumar Prajapati

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** Limitations of conventional manufacturing processes, need of unconventional manufacturing processes and its classification.	**08**
	Module-2	**Unconventional Machining Process**: Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, ultrasonic machining, Abrasive jet machining etc.	
UNIT-2	*Module-3*	**Principle and working and application of unconventional machining processes** such as laser beam machining, Electron beam machining, Ultrasonic machining etc.	**08**
UNIT-3	*Module-4*	**Unconventional Welding Processes:** Explosive welding, Cladding etc. Under water welding, Metallizing, Plasma arc welding/cutting etc.	**08**

UNIT-4	*Module-5*	**Unconventional Forming Processes**: Principle, working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, water hammer forming, explosive compaction etc.	**08**
UNIT-5	*Module-6*	**Introduction to the Basic Principles of Additive Manufacturing/digital Manufacturing**: Advantages and limitations of AM technologies AS developing new engineering systems, identifying emerging opportunities in developing products for mass customization .Additive Manufacturing Processes	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: ● Summarize the needs and classification of unconventional machining process. ● Understand the various input and output parameters that influence in the performance. ● Explain the working principle of energy based machining process. ● Compare the merits, demerits and applications of unconventional machining process. ● Identify the electric discharge machining and wire cut electric discharge machining process ● Select the material and tool with respect to the process.

Suggested books:

. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	P.C. Pandey***, Modern Machining Processes,*** McGraw Hill Education, ISBN- 978-0070965539	1980
2.	V.K Jain, ***Unconventional Machining,*** Allied Publishers Pvt. Ltd.; 1st Ed., ISBN-978-8177642940	2019
3.	Ian Gibson, David W. Rosen, Brent Stucker, "***Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing***", 1st Ed.,Springer Publ., ISBN- 978-1-4419-1119-3	2010

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Course Code: BME- P723/ BME-P823

Course Name: Advanced Welding Processes

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Conventional welding and Weld Design
Objectives:	● Able to get the knowledge of various conventional and advanced welding techniques which make them interested to choose a career in the field of welding. ● To impart knowledge on various advanced welding processes so that the students can apply them in engineering industry applications. ● To develop the knowledge on the design of welded joints and the quality control of weldments.
CourseCoordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Introduction:** Importance and application of welding, classification of welding process. Selection of welding process.	**03**
	Module -2	**Review of conventional welding process:** Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electro slag welding, Friction welding etc. Welding of MS.CI, Al, Stainless Steel & Maurer/Schacfflar Diagram. Soldering & Brazing	**05**
UNIT-2	*Module -3*	**Advanced welding Techniques:** Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.	**07**
UNIT-3	*Module -4*	**Advanced welding Techniques (continued):** Principle and working and application of advanced welding techniques such as explosive welding/ cladding,	**03**
	Module -5	Underwater welding, Spray-welding /Metallizing, Hard facing.	**06**

UNIT-4	*Module -6*	**Weld Design:** Welding machines/equipments and its characteristics. Weld defects and distortion and its remedies, Inspection/testing of welds	**05**
	Module-7	Macrostructure & microstructure of welds, HAZ, Weld Design, Welding of pipe-lines and pressure vessels. Life predication.	**04**
UNIT-5	*Module-8*	**Thermal andMetallurgical Consideration:** Thermal considerations for welding, temperature Distribution,Analytical analysis, heating & cooling curves. Metallurgical consideration of weld, HAZ and Parent metal, micro & macro structure. Solidification of weld and properties.	**08**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: ● Apply the knowledge of solid state welding process for engineering applications. ● Understand the principles of radiant energy metal joining process ● Understand the fundamental principles of special arc welding process. ● Understand the knowledge of plasma arc in metal joining and cutting process. ● Understand the knowledge of design principles in weld joints. Apply the concept of quality control and testing of weldments in industrial environment.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bruce Stirling , ***Text Book Of Welding Technology,*** Dhanpat Rai Publications, ISBN- 978-8189928360	2013
2.	Richard L. Little,***Welding and Welding Technology***, McGraw-Hill Inc., ISBN- 978-0070380950	1973
3	Parmer R. S., ***'Welding Engineering and Technology'***, Khanna Publishers, 2nd Ed., ISBN- 978-8174091260	1996
4	Bowditch, William A., Bowditch, Kevin E., Bowditch, Mark A, ***Welding Technology Fundamentals,*** **4th Ed.,** Goodheart-Willcox Co., ISBN- 978-1605252568	2009

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Course Code: BME-P725/ BME-P825

Course Name: Thermal Power Plant Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Engineering Thermodynamics, Fluid Mechanics, Heat Transfer
Objectives:	To introduce students to different aspects of power plant engineering ● To familiarize the students to the working of power plants based on different fuels. ● To expose the students to the principles of safety and environmental issues.
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Introduction**: Analysis of steam cycles, optimization of reheat pressure and degree of regeneration, coupled cycles and combined plants, process heat and power. Fuels and their properties, stoichiometric and actual air requirements, flue gas analysis.	**08**
UNIT-2	*Module -2*	**Boilers**: Different types of boilers, boiler mountings, feed water treatment, boiler loading and manner of operation. Boiler energy balance, draft system. Different types of furnaces for burning coal, fuel oil and gas. Circulation theory, down-comers and risers, economizers and super-heaters, air pre-heater, drum and its internals.	**08**
UNIT-3	*Module-3*	**Steam Turbines**: Convergent and convergent-divergent nozzles - theory and design. Impulse and reaction turbines, compounding of turbines, optimum velocity ratio, reheat factor and condition line, parallel exhaust, losses in steam turbines, steam turbine governing.	**08**
UNIT-4	*Module -4*	**Plant Components**: Theory and design of condensers, air ejector and cooling towers. Types and applications.	**08**

UNIT-5	*Module -5*	**Power Plant Economics & Environmental Considerations**: Plant energy studies: concepts and resources, procedures and implementation. Energy accounting. Various thermal systems and energy management. Electrical load management. Economic analysis. Waste heat recovery. Multi objective energy management- conservation, pollution control and evaluation of alternative energy sources. Cost of energy management and payback.	**08**
Total No. of Hours			**40**

Learning Outcomes:	After learning the course the students should be able to: ● Understand the different power generation methods, its economics and global energy situation ● Apply the basic thermodynamics and fluid flow principles to different power generation methods ● Analyze thermodynamic cycles of steam power plant and understand construction, working and significance of its various systems ● Analyze thermodynamic cycles of gas turbine power plant, nuclear power plant and jet propulsion systems

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Nag P.K., "***Power plant engineering***", 3rd Ed., Tata McGraw-Hill., ISBN-978-0070648159	2007
2.	Arora S. C., & Domkundwar S., "***A course in power plant engineering***",8th Ed., Dhanpat Rai, ISBN- 978-8177001952	2016
3.	Elanchezhian C., "***Power Plant Engineering***", I.K. International Pub. House, ISBN-978-8189866303	2013
4.	Sharma P. C., "***Power Plant Engineering***", S. K. Kataria & Sons, ISBN- 978-9350143841	2013
5.	Drbal L. F., Boston P. G., Westra K. L., Black, & Veatch, "***Power plant engineering***", Chapman & Hall, ISBN- 978-0412064012	1995
6.	Skrotzki B. G. A., & Vopat W. A., "***Power station engineering and economy****",* 2nd Ed., McGraw- Hill, ISBN- 978-0070579408	1960

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Course Code: BME-P726

Course Name: Flexible Manufacturing System

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit: 3**

Prerequisites:	
Objectives:	A flexible manufacturing system (FMS) gives manufacturing firms an advantage to quickly change a manufacturing environment to improve process efficiency and thus lower production cost. However, upfront costs may be greater for installing specialized equipment that allows for flexibility and customization. This course imparts knowledge of FMS evolution, objectives, applications and focuses on FMS layout, processing stations material handling systems etc.
Course Coordinator	Kapil Dev Sharma

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT/MODULE	Course Content	No. of Hours
UNIT1/ MODULE1	**Introduction:** Evolution of FMS, Definition, FMA Layout configurations,-Inline layout, loop layout, loader layout, open field layout, robot configured layout, general FMS considerations, functions of FMS, FMS Justification, Cell/FMS Justification Flow chart.	**8**
UNIT2/ MODULE2	**Manufacturing cells and Unattended Machine**: Introduction, Classification of manufacturing cells-Stand alone NC machine cell, Spindle NC machine cell, Integrated multi machine cell, FMS Unattended Machining: Introduction, unattended turning center features and requirements, unattended machining center features and requirements, cellular Vs flexible manufacturing.	8
UNIT3/ MODULE3	**QUALITY:** Definition, characteristics of quality, Quality improvements, Importance of Quality to cells and systems, Quality of team work, Methods for getting and keeping quality under control-statistical process control and taguchi methods. Just In-Time (JIT) Manufacturing, Benefits of JIT, JIT Relation to FMS, Primary JIT principles.	8
UNIT4/ MODULE4	**Software for FMS:** Introduction, flexibility targets, system concepts-sequential flow system, single station system, random flow system, software for design functions-capacity planning, simulation and knowledge based system, software for extrinsic functions-production scheduling, process planning, tool management, maintenance	8

	planning/reporting, software for intrinsic functions-production control, production monitoring, MLR Institute of Technology B.Tech –Mech Academic Regulations & Syllabus– MLR18 Page 165 machine/process control, Machine diagnostics. Software Specifications-absolute specifications and functional specifications, FMS database- Database layout and sub systems. UNIT-V FMS PLANNING, HARDWARE & IMPLEMENTATIO	
UNIT5/ MODULE5	**FMS Planning:** CAD Considerations FMS planning, CAM Considerations for FMS planning. Hardware: FMS hardware configurations and considerations, Programmable logic controllers(PLC'S)- components of PLC, advantages of PLC,Cell controllers, Communication networks-star network, ring network and bus network. FMS Implementation: Acceptance testing, Performance goals and expectations, Maintenance concerns and continued support.	8
Total No. of Hours		**40**

Learning Outcomes:	At the end of the course, the student shall be able to 1. Demonstrate basic concepts of flexible manufacturing systems. 2. Discuss concepts of manufacturing cells and unattended machining. 3. Explain in detail about manufacturer's driving force. 4. Discuss about software for FMS. 5. Explain FMS planning, hardware and implementation. .

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	1. William W Luggen, "Flexible Manufacturing Cells and System" Prentice Hall of Inc New Jersey, 1991	1991
2.	2. Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991	1991
3.	3. John E Lenz "Flexible Manufacturing" marcel Dekker Inc New York ,1989.	1989

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Course Code: BME-P727/ BME-P827

Course Name: Additive Manufacturing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	The student should have completed 2 semesters of UG Engg.
Objectives:	• In this course students will learn the importance of additive manufacturing (3D Printing/ Rapid Prototyping/ Green Manufacturing) and its huge role in global product development and innovation. • The students will learn the latest trends and opportunities in 3D printing, including ―personal‖ 3D printing, localized services, production parts, mass customization, and how to commercialize your ideas.
Course Coordinator	Mr. Rishi Kumar Prajapati, Mr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Introduction to the Basic Principles of Additive Manufacturing/digital Manufacturing: advantages and limitations of AM technologies AS developing new engineering systems, identifying emerging opportunities in developing products for mass customization.	**04**
	Module -2	Additive Manufacturing Processes	**02**
UNIT-2	*Module -3*	**AM Technology:** Extrusion, Beam Deposition, Jetting, Sheet Lamination, Direct-Write, Photo polymerization, Metal Technology & Processes, Sintering, and Powder Bed Fusion.	**06**
UNIT-3	*Module -4*	**Design/Fabrication Processes**: Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, design practices for additive manufacturing.	**05**
	Module -5	**Designing for Additive Manufacturing**: Scaffolds, bioprinting, tissue and organ engineering	**04**

UNIT-4	*Module -6*	Multiple Materials, Metals, polymers, ceramics, Hybrids, Composite Materials, current and material Selection & future directions, Process & Material Selection.	**05**
	Module -7	Direct Digital Manufacturing and Distributed Manufacturing, Related Technologies:3D scanning, sintering, Mold,Casting, Scanning, rapid tooling (RT), rapid manufacturing (RM).	**06**
UNIT-5	*Module-8*	**Applications of AM**: Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewelry, Toys, Packaging, Architecture, Design and Entertainment and many more.	**02**
	Module-9	**Biomedical Applications of AM**: Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.	**02**
	Module-10	Future Trends and Directions in Additive Manufacturing, Business Opportunities, Standards and standardization in 3D Printing and theFutureof Manufacturing,Intellectual Property, ProductDevelopment,Commercialization	**04**
Total No. of Hours			**40**

Learning Outcomes:	● Understanding the evolution and need of AM processes. It will develop the ability of select the process for particular application. ● Understanding the basic principle of curing type, extrusion and layer deposition type AM processes. The students will learn the pros & cons of these processes and their applications. ● The students will understand the use of pre requirement of AM process. Basic knowledge about the software requirement and processing of drawing. ● The students will learn about the post processing requirements of different AM processes ● Appreciate the operating principles, capabilities and limitations of powder based additive manufacturing system, including 3D printing and laser sintering. ● Describe the important process parameters for bio-manufacturing and determine the suitable additive technique for bio manufacturing.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Ian Gibson, David W. Rosen, Brent Stucker, "***Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing***", 1st Ed., Springer Publ., ISBN-978-1-4419-1119-3	2010
2.	Hopkinson, N, Haque, R., and Dickens, P., "***Rapid Manufacturing: An Industrial Revolution for a Digital Age: An Industrial Revolution for the Digital Age***", Wiley, ISBN- 978-0470016138	2005
3.	Bartolo P J (editor), "***Virtual and Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping***", 1st Ed , Taylor and Francis, ISBN- 9780203931875	2007
4.	Chua C. K., Leong K. F., Lim C. S., "***Rapid Prototyping***", World Scientific, ISBN-978-981-3106-04-8	2003
5.	Pique A., Chrisey D. B., "***Direct Write Technologies for RP Applications: Sensors, Electronics and Integrated Power Sources***", 1st Ed, Academic Press, ISBN-9780121742317	2001
6.	Venuvinod P. K., Ma W., "***Rapid Prototyping – Laser Based and Other Technologies***", Kluwer, ISBN- 978-1-4757-6361-4	2004
7.	Andreas Gebhardt, "***Understanding Additive Manufacturing***", Hanser Publ., ISBN-978-1569905074	2012
8.	Gibson, "***Advanced Manufacturing Technologies for Medical Applications"***, Wiley, ISBN- 978-0-470-01688-6	2005

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Course Code: BME-P728/ BME-P828

Course Name: Finite Element Methods

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Matrix Algebra & Basic Mathematics courses.
Objectives:	• The objective of the course is to apprise the students about the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems in solid mechanics. • Different application areas will be dealt with after introducing the basic aspects of the method.
Course Coordinator	Dr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Basic concepts**: The standard discrete system, Finite elements of an elastic continuum displacement approach, Generalization of the finite element concepts- weighted residual and vibrational approaches.	**08**
UNIT-2	*Module-2*	**Element Types**: Triangular, rectangular, quadrilateral, sector, curved, iso-parametric elements and numerical integration. Automatic mesh generation schemes.	**12**
UNIT-3	*Module-3*	**Application to structural mechanic's problems**: Plane stress and plane strains, Axisymmetric stress Analysis ,three dimensional stress analyses, bending of plates.	**06**
UNIT-4	*Module-4*	**FEM in Steady State Field Problems**: Introduction, heat conduction, fluid flow and nonlinear material problems, plasticity, creep etc.	**08**
UNIT-5	*Module-5*	Computer procedures for Finite element analysis.	**06**
Total No. of Hours			**40**

Learning Outcomes:	After the completion of the course, the students will be able to: 1. Describe the fundamental ideas of FEM and know the behavior and usage of different elements. 2. Prepare a FEM model for structures. 3. Analyze structure using a software. · Interpret and evaluate the results.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Chandrupatla T. R., and Belegundu A. D., "***Introduction to Finite Elements in Engineering***", 4th Ed, Pearson Education, ISBN- 978-0132162746	2011
2.	David V Hutton, "***Fundamentals of Finite Element Analysis****",* International Ed. McGraw-Hill Int., ISBN- 978-0071218573	2003
3.	Rao S.S., "***The Finite Element Method in Engineering***", 5th Ed, Pergammon Press, ISBN- 978-1856176613	2010
4.	Logan D.L., "***A First course in the Finite Element Method***, 5th Ed., Thomson Learning, ISBN- 978-0495668251	2010
5.	Robert D. Cook., David. S, Malkucs Michael E Plesha, "***Concepts and Applications of Finite Element Analysis****",* 4th Ed., Wiley, ISBN- 978-0471356059	2001
6.	Reddy J.N, "***An Introduction to Finite Element Method***", 3rd Ed, McGraw-Hill International Student Edition, ISBN- 978-0072466850	2005
7.	O. C. Zienkiewicz and R. L. Taylor, "***The Finite Element Methods, The basic formulation and linear problems Vol.1****",* Ed, McGraw-Hill College;, ISBN- 978-0070841741	1987

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Course Code: BME-P730

Course Name: Renewable Energy Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit: 3**

Prerequisites:	
Objectives:	1. To acquire knowledge of technical competency combined with research to generate innovative solutions in Energy engineering. 2. To be acquainted with a variety of options in energy sources. 3. To prepare the students to exhibit a high level of professionalism, integrity, environmental and social responsibility, and life-long independent learning ability with environment in mind.
Course Coordinator	Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT/MODULE	Course Content	No. of Hours
UNIT1/MODULE-1	**Introduction:** Basic concepts of energy; Introduction to Renewable Energy Technologies; Energy and Environment – global warming, acid rains, depletion of ozone layer; Global and Indian Scenario of renewable energy sources; Energy storage - necessity and energy storage methods. Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data.	**8**
UNIT2/MODULE-2	**Solar Thermal Systems**: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems. Solar Photovoltaic Systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems.	10
UNIT3/MODULE-3	**Wind Energy**: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems.	7

UNIT4/MODULE-4	**Fuel cells:** Overview; Classification of fuel cells; Operating principles; Fuel cell thermodynamics. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.	10
UNIT5 /MODULE-5	**Other forms of Energy:** Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles.	**5**

Total No. of Hours	**40**

Learning Outcomes:	At the end of this course students will demonstrate the ability to 1. Acquire, apply and share in depth knowledge in the area of Energy Engineering and Management. 2. An ability to apply engineering and scientific principles for the effective management of energy systems..

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	O.P. Gupta, "Energy Technology", Khanna Book Publishing, New Delhi.	2013
2.	V.V.N. Kishore, "Renewable Energy Engineering and Technology: Principles and Practice," Routledge, 1st Edition, 2019	2019
3.	N. Jenkins and J. Ekanayake, "Renewable Energy Engineering," Cambridge University Press, 1st Edition, 2017.	2017
4.	G. Boyle, "Renewable Energy," OUP Oxford, 2nd Edition, 2009.	2009

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Course Code: BME-P731

Course Name: 3 D Printing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Pre-requisites: Basics of Engineering Graphics, Product design and Computer Aided Design
Objectives:	Course Objectives: The objective of this course is to impart students to the fundamentals of various 3D Printing Techniques for application to various industrial needs. Student will be able to convert part file into STL format and will understand the method of manufacturing of liquid based, powder based and solid based techniques
Course Coordinator	Mr. Praveen Kumar Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Introduction to Design, Prototyping fundamentals. Introduction to 3D printing, its historical development, advantages. Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of 3D printing process, Applications to various fields.	**8**
UNIT-2	*Module-2*	Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies.	**8**
UNIT-3	*Module-3*	Solid ground curing (SGC): Models and specifications, process, working ,principle, applications, advantages and disadvantages, case studies	**8**
UNIT-4	Module-4	Laminated object manufacturing(LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.	8
UNIT-5	Module-5	Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration	8
Total No. of Hours			**40**

• **Learning Outcomes:**	1. Use software tools for 3D printing 2. Prepare 3D printed modules 3. Construct products using LOM and FDM technologies

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010	2010
2.	. D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001	2001
3.	Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000	2000
4.	.Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996	1996

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Course Code: BME-P732

Course Name: Design for Manufacturing & Assembly

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	None
Objectives:	The Design for Manufacturing and assembly is challenging subject, the aim of present course is to introduce and aware students about the basic design process which based on different aspects of manufacturing as well assembly. • Student will have idea about different criteria made on design such as machining and casting. They also have knowledge on Environment factors.
Course Coordinator	Dr. Sanjeev Kumar Lambha/ Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	**Introduction:** General design principles for manufacturability: strength and mechanical factors, mechanisms selection, evaluation method, Process capability: Feature tolerances, Geometric tolerances, Assembly limits, Datum features, and Tolerance stacks.	**8**
UNIT-2	*Module-2*	. **Factors Influencing form Design**: Working principle, Material, Manufacture, Design- Possible solutions, Materials choice, Influence of materials on form design, form design of Welded members, forgings and castings.	**8**
UNIT-3	*Module-3*	**Component Design**-I: Machining Consideration: Design features to facilitate machining: drills, milling cutters, keyways, Doweling procedures, counter sunk screws, Reduction of machined area, simplification by separation, simplification by amalgamation, Design for machinability, Design for economy, Design for clamp ability, Design for accessibility, Design for assembly.	**8**
UNIT-4	*Module-4*	**Component Design-II**: Casting Consideration: Redesign of castings based on parting line considerations, minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, group technology, Computer Applications for DFMA.	**8**
UNIT-5	*Module-5*	**Design for the Environment:** Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guide lines, Example application, Lifecycle assessment, Basic method, Environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for	**8**

		disassembly, Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.	
Total No. of Hours			**40**

Learning Outcomes:	1Students will have knowledge on design principles for manufacturability 2 Students will have knowledge Influencing factors on Design. 3 Students will have knowledge on Machining consideration while design. 4 Students will have knowledge on casting consideration while design. 5 Students will have knowledge on environment consideration while design. 6 Students will have ability to understand contemporary issues and their impact on design for manufacturing and assembly.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004.	2004
2.	Product design and development, by K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill	2019
3.	Boothroyd, G, 1980 Design for Assembly Automation and Product Design. New York, Marcel Dekker.	1980
4.	Bralla, Design for Manufacture handbook, McGraw Hill, 1999.	1999
5.	Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.	1994
6.	Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.	1995

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Course Code: BME-P734

Course Name: Biofuels

MM: 100 **Time: 3 Hr.** **LTP** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit: 3**

Prerequisites:	
Objectives:	• To understand the concepts of green Energy. • To know the sustainability & its classification in details. • To understand type of biofuels and feed stocks. • To understand and produce biodiesel. • To learn broader understandings on various aspects of solid waste management practiced in industries. • To learn recovery of products from solid waste to compost and biogas, incineration and energy recovery.
Course Coordinator	Dr. Sunil Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT/MODULE	**Course Content**	**No. of Hours**
UNIT1/ MODULE1	Introduction to the nexus between energy, environment and sustainable development, Energy sources over view and classification, sun as the source of energy, fossil fuel reserves and resources. Introduction to Renewable Sources of Energy; Solar Energy, Wind Energy, Ocean Energy, and Bioenergy.	**8**
UNIT2/ MODULE2	Concept of Sustainability. Three pillars of sustainability. Challenges in sustainability. Need of sustainability. Nexus between technology and sustainable development. Sustainable Development Goals (SDGs).	8
UNIT3/ MODULE3	Bioenergy: Biomass, type of biomass. Biomass production System and their Categorization. Type of fuels. Biofuels, types of biofuels, Biofuels Properties.	8
UNIT4/ MODULE4	Biofuels production: - Fuel production technique. Factor affecting in process. Types of reactors. Testing of biofuels. diesel engine. Performance and emission testing of biodiesel. Future scope. Experimentation in production.	8

UNIT5/ MODULE5	Introduction of Municipal Solid Waste, Characteristics and Quantities, Collection, Transportation, Segregation and Processing. Energy Recovery from Municipal Solid i.e., Incineration, Landfill, Anaerobic Digestion, Gasification and Composting etc.	8
Total No. of Hours		**40**

Learning Outcomes:	• Make interpretation about the energy sources. • categorize producers and consumers in an ecosystem. • Describe the nature and principle of different biomass energy extraction systems and know how to choose the suitable biomass fuels for different bio-energy applications. • Apply the basics of solid waste management towards sustainable development CO_2 • Apply technologies to process waste and dispose the same.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bioenergy: Biomass to Biofuels-AP publisher	2014
2.	Introduction to Bioenergy (Energy and the Environment) by Vaughn C. Nelson (Author), Kenneth L. Starcher (Author)	2016
3.	Bioenergy: Sustainable Perspectives by Ted Weyland- Callisto	2016
4.	William A Worrell and P. Aarne Veslind, "Solid Waste Engineering", 2nd Edition Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)	2012
5.	White, F. R., Franke P. R., & Hindle M., Integrated solid waste management: a life cycle inventory. Mc Dougall,P. John Wiley & Sons.	2001
6	The Central Public Health and Environmental Engineering Organization (CPHEEO), "Manual on Solid Waste Management", India, 2016.	2016

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Open Elective – II/ III (Seventh/ Eighth Semester)

Course Code: BME-O731/ BME-O831
Course Name: Nanotechnology and Nano Computing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	First two years of undergraduate course of Engineering (Introductory, undergraduate level Physics, Chemistry and Mathematics)
Objectives:	● To foundational knowledge of the Nano computing and related fields. ● To make the students acquire an understanding the Nano computing and Applications ● To help them understand in broad outline of Nano computing and Nanotechnology
Course Coordinator	Dr. Jasbir Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Nanotechnology:** Nano systems, Molecular machinery and manufacturing, quantum mechanics, mechanic synthesis, Ideas of Richard Feynman	**04**
	Module -2	**Nano computing:** Introduction, Nano computing Technologies, Carbon nanotubes, Nano Information processing, Silicon Nano electronics, prospects and Challenges.	04
UNIT-2	*Module -3*	**Carbon Nano tubes:** Properties, Molecular structure, Chiral Vector, carbon Nano tube Electronics, Carbon Nano tube Field effect Transistors	**08**
UNIT-3	*Module -4*	**Nano computing with Imperfections:** Nano computing in presence of defects and faults, redundancy, Error control coding, reconfiguration, Fault Simulation, Defect Tolerance, Reconfigurable Hardware, Overcoming Manufacturing defects	**05**

	Module -5	**Reliability of Nano computing:** Markov Random Fields, examples, reliability Evaluation strategies ,Law of large Numbers, Nano prism.	**03**
UNIT-4	*Module -6*	**Nanoscale Quantum Computing:** Quantum Computers, Challenges to Physical Realization, Quantum-dot Cellular Automata (QCA), QCA Clocking, Design Rules, Placement, Basic QCA Circuits using QCA Designer Software and their implementation	**08**
UNIT-5	*Module-7*	**Molecular Computing:** Background of molecular electronics, Alderman's Experiment, DNA Computation, Bacteriorhodopsin, challenges before molecular computing. Optical Computing: Introduction, use of Optics for Computing, Optical Computing Paradigms, Ultrafast Pulse Shaping, Photonic Switches	**08**
Total No. of Hours			**40**

Learning Outcoms:	After completing this course student will be able to: ● Learn about the background on Nano computing ● Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment ● Apply their learned knowledge to develop Nanomaterial's.

Suggested books:

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	G. Schmidt , ***Nanoparticles: From theory to applications*** , Wiley Weinheim, ISBN-978-3-527-60404-3	2006
2.	S K Shukla and R I Bahar , ***Nano, Quantum and Molecular Computing- Implications to High level design and Validation***, Illustrated Ed., Kluwer Academic Publishers, ISBN- 978-1402080678	2004
3.	V Sahni and D Goswami, ***Nanocomputing – an Introduction***, Tata McGraw Hill, ISBN- 978-0070248922	2008
4.	Leon L. Shaw***, "Processing & properties of structural naonmaterials",*** Wiley , ISBN- 978-0873395588	2003

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Course Code: BME-O732/ BME-O832

Course Name: Artificial Intelligence and Machine Learning

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	: Knowledge of "Kinematics of Machine" & Passion to learn the Subject
Objectives:	• To present a problem oriented in depth knowledge of Artificial Intelligence and Robotics. • To address the underlying concepts, methods and application of different Artificial Intelligence and Robotics.
Course Coordinator	Dr. Sanjeev Kumar Lambha

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Scope of AI**: Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction.	**04**
UNIT -2	*Module -2*	**Problem solving**: State space search; Production systems, search space control: depth first, breadth-first search, heuristic search - Hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis.	**08**
UNIT -3	*Module -3*	**Knowledge Representation**: Predicate Logic: Unification, modus pones, resolution, dependency directed backtracking. Rule based Systems: Forward reasoning: conflict resolution, backward reasoning: use of no backtrack. Structured Knowledge Representation: Semantic Nets: slots, exceptions and default frames, conceptual dependency, scripts.	**10**
UNIT -4	*Module -4*	**Handling uncertainty and learning**: Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic. Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.	**08**

UNIT -5	*Module -5*	**Robotics**: Robot Classification, Robot Specification notation; Direct and Inverse Kinematics: Co-ordinates Frames, Rotations,	**10**
		Homogeneous Coordinates, Arm Equation of four Axis SCARA Robot, TCV, Inverse Kinematics of Four Axis SCARA Robot.	
Total No. of Hours			**40**

Learning Outcomes:	● The student can identify different areas of Artificial Intelligence and Robotics. ● Can find the applications of all the areas in industry.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	E. Rich and K. Knight, "***Artificial intelligence***", 2nd Ed., TMH, ISBN- 978-0070522633	1991
2.	N.J. Nilsson, "***Principles of AI***", Reprint Ed, Narosa Publ. House, 978-0934613101	1993
3.	Robin R Murphy, "***Introduction to AI Robotics***", 1st Ed., PHI Publication, ISBN-978-0262133838	2001
4.	D.W. Patterson, "***Introduction to AI and Expert Systems***", PHI, ISBN- 978 0134771007	1990
5.	R. J. Schalkoff, "***Artificial Intelligence - an Engineering Approach***", Int. Ed., McGraw Hill, Singapore, ISBN- 978-0071009324	1992
6.	George Lugar, "***Al-Structures and Strategies for and Strategies for Complex Problem solving***", 6th Ed., Pearson Educations, ISBN- 978-0321545893	2008

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Course Code: BME-O733/ BME-O833

Course Name: Green Energy Technology

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	First two years of undergraduate course of Engineering (Introductory, undergraduate level Physics and Chemistry)
Objectives:	● To provide students with a general awareness on the importance of energy and its conservation, its impact on society, various energy sources, energy conversion processes, energy management.
Course Coordinator	Mr. Praveen Pandey

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module -1*	**Energy Resources and Their Utilization:** Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.	**04**
	Module -2	**Solar Radiations:** Extra-terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Flux on a plane surface, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.	**04**
UNIT-2	*Module -3*	**Solar Energy:** Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar	**4**

		concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants.	
	Module-4	**Solar Photovoltaic System:** Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.	**04**
UNIT-3	*Module-5*	**Biogas:** Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.	**04**
	Module-6	**Wind Energy:** Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis windmills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.	**04**
UNIT-4	*Module-7*	**Electrochemical Effects and Fuel Cells:** Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells .	**04**

	Module-8	**Tidal power:** Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy, limitations of tidal energy conversion systems. **Hydrogen Energy:** Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.	**04**
UNIT-5	*Module-9*	**Thermoelectric Systems:** Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators.	**04**
	Module-10	**Geothermal Energy:** Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station With schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.	**04**
	Module-11	**Ocean Energy:** Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion Systems, Thermoelectric OTEC, Developments of OTEC, Economics. Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy Sources, Energy options for Indian economy.	**04**
Total No. of Hours			**40**

Learning Outcomes:	After completion of this course ● The students shall have an understanding of the impact of energy on society, the need for sustainable energy, global and Indian energy policies. ● They would have gained knowledge on various techniques of energy management and conservation.

Suggestedbooks:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bansal Keemann, Meliss***," Renewable energy sources and conversion technology"***, Tata Mc Graw Hill, Publisher, ISBN- 978-0074600238	1989
2.	Kothari D.P., ***"Renewable energy resources and emerging technologies", 2nd Ed., Prentice Hall of India Pvt. Ltd***., ISBN- 978-8120344709	2011
3.	Rai G.D, ***"Non-Conventional Energy Sources",*** Khanna Publishers., ISBN- 978-8174090737	1988
4.	Ashok V. Desai, ***"Nonconventional Energy",*** New Age International Publishers Ltd., ISBN- 978-8122402070	1990

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CourseCode: BME-O734/834
Course Name: Composite Materials

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Strength of material, Material Science.
Objectives:	1. To understand the mechanical behaviour of composite materials 2. To get an overview of the methods of manufacturing composite materials
Course Coordinator	Dr. Mayank Pokhriyal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	*Module-1*	Definition and applications of composite materials, Fibers-glass, carbon, ceramic and aramid fibers; Matrices-polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. .	**03**
	Module-2	Lamina-assumptions, macroscopic viewpoint, generalized Hooke's law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, and transformed stiffness.	**04**
UNIT-2	*Module-3*	Manufacturing of composite materials, hand layup processes – spray up process	**03**
		compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding	**05**
UNIT-3	*Module-4*	Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties	**03**

	Module-5	Determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates.	**06**
UNIT-4	*Module-6*	Characteristics of MMC, various types of metal matrix composites, alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibers. Effect of reinforcement – volume fraction – rule of mixtures.	**03**
	Module-7	Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties- applications of MMC in aerospace, automotive industries	**05**
UNIT-5	*Module-8*	Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, freevibrations, natural frequencies. Testing of composites:	**04**
	Module-9	Physical, Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties	**04**
Total No. of Hours			**40**

Learning Outcomes:	At the end of the course students are able to: 1. Upon completion of this course, the students will have an overview of the 2. Mechanical behaviour and application of composite materials 3. Use of different techniques to process different types of composites and know the limitations of each process. 4. Explain the need of the research in the composite materials to fulfill the demand of the hi-tech applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill	1994
2.	Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill.	1998
3.	Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England.	1994
4.	Chawla K. K., "Composite materials", Second Edition, Springer – Verlag.	1998

Course Code: BME-O736

Course Name: Bio Medical Engineering

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	None
Objectives:	1.To introduce the field of biomedical engineering and role of biomedical engineers in society. 2.To impart knowledge on principles of various diagnostic, therapeutic equipment. 3Achieve familiarity with some basic ethical framework and medical standards to be followed in hospitals.
Course Coordinator	Dr. Mayank Pokhriyal and Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours
UNIT-1	Module-1	**Introduction:** Historical Perspective-Evolution of modern healthcare System-Role of Biomedical engineers in various domain - Professional status of biomedical Engineering-General constraints in design of medical instrumentation systems	**8**
UNIT-2	Module-2	**Fundamentals of Medical Instrumentation:** Anatomy and Physiology – Sources of biomedical signals- basic medical instrumentation System-General block of medical instrumentation system – Performance requirements –General constraints in design of medical instruments.	**8**
UNIT-3	Module-3	**Diagnostic Imaging:** X-rays, Nuclear Medical Imaging-Positron Emission Tomography-Magnetic Resonance Imaging Scanners-Diagnostic Ultrasound- Thermal imaging systems	**8**
UNIT-4	Module-4	**Introduction to Biomedical Equipment** :ECG,EEG -Cardiac Pacemakers Cardiac Defibrillators – Hemodialysis Machines-Artificial Kidney Dialyzers-Ventilators-Humidifiers, Nebulizers and Aspirators- Anesthesia Machine.	**8**
UNIT -5	Module-5	**Medical standards and regulations**: Institutional Review Boards – Good Laboratory Practices -Good Manufacturing Practices - Human factors. Morality and Ethics-A Definition of terms, Human Experimentation-Ethical issues in feasibility studies, Ethical issues	**8**

		in emergency use, Ethical issues in treatment use-Codes of ethics for bio engineers.	
Total No. of Hours			**40**

Learning Outcomes:	1.Interpret the role of biomedical engineering in society. 2.Demonstrate the principles of various diagnostic devices. 3.Identify the various techniques used in diagnosis though imaging. 4.Describe the working principles of various therapeutic and assist devices. 5.Understand device specific safety goals and standards. 6.Illustrate the concepts of ethical theories and moral principles for the health professions.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	1. Enderle, John D, Bronzino, Joseph D, Blanchard, Susan M- Introduction to Biomedical Engineering- ElsevierInc2ndedition,2005.	2005
2.	2. R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw-Hill Publishing Company Limited, 2ndedition,2003.	2003
3.	3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi,2nd edition, 2002	2002
4.	Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York,4th edition, 2008	2008