DAV UNIVERSITY JALANDHAR

Course Scheme & Syllabus

For

Doctor of Philosophy- Mechanical Engineering (Full Time/Part Time)

Syllabi Applicable For Admissions in 2023 Onwards

PROGRAMME EDUCATIONAL OUTCOMES (PEOs)

After the successful completion of undergraduate course, Mechanical Engineering, Graduates will be able to:

PEO1: Plan, design, construct, maintain and improve mechanical engineering systems that are technically sound, economically feasible and socially acceptable.
PEO2: Apply analytical, computational and experimental techniques to address the challenges faced in mechanical and allied engineering streams.
PEO3: Communicate effectively using conventional platforms as well as innovative / online tools and demonstrate collaboration, networking & entrepreneurial skills.
PEO4: Exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning to achieve career, organizational and societal goals.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PROGRAMME SPECFIC OUTCOMES (PSOs)

PSO1: Apply mechanical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society.
PSO2: Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.

Scheme of Courses
Ph D Mechanical Engineering (Full Time/Part Time)

S.NO.	Course Code	Course Title	L	T	P	Cr	Nature of Course
1.	XXX	Research Methodology	4	0	0	4	MC
2.	XXX	Foundation Course	4	0	0	4	PC
3.	XXX	Specialization Course	4	0	0	4	PC
4.	XXX	Research and Publication Ethics (RPE)	2	0	0	2	MC
							Total=14 CR

L: Lectures T: Tutorial P: Practical Cr: Credits

List of Foundation Courses, Specialization Courses

S.NO.	Course Code	Course Title	L	T	P	Cr	Nature of Course
1	MEDXXX	Production Processes and Analysis	4	0	0	4	PC
2	MEDXXX	Engineering Tribology	4	0	0	4	PC
3	MEDXXX	Composite Materials	4	0	0	4	PC
4	MEDXXX	Additive Manufacturing	4	0	0	4	PC

Note:

- *Department can also offer other courses other than above courses mentioned in list, keeping in view the interdisciplinary research as per university guidelines.*

Detailed Syllabus

Course Code	MEDXXX						
Course Title	**Production Processes and Analysis**						
Course Outcomes	On the completion of the course the student will be able to: CO1: To understand the fundamental principles of materials, processes and manufacturing. CO2: To gain knowledge of various manufacturing processes and related technical analysis. CO3: To apply the various manufacturing processes in engineering applications. CO4: To evaluate the importance of economic considerations in the selection of manufacturing processes						
Examination Mode	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MTP	ESE	EPR	ABL/PBL
Weightage	10%	10%	25%	-	50%	-	5%
Syllabus							**CO Mapping**
Unit 1	***Metal Casting and Forming***						
	Classification of manufacturing processes, various kinds of Production System, casting, Pattern types, Allowances for pattern, pattern, materials, Moulding methods and Processes, Moulding materials, Moulding sands and its ingredients, Properties, Cores, Sand casting defects, Design of castings. Metallurgical aspects of metal forming slip, twining mechanics of plastic deformation effects of temperature, strain rate-microstructure and friction in metal forming, Classification of metal forming processes. Classification of extrusion processes their principles, influence of friction, Extrusion force calculation, Defects and analysis: Rod/wire drawing-tool, equipment and principle of processes defects, Tube drawing and sinking processes						CO1
Unit 2	***Advanced Machining process***						
	Ultrasonic machining, abrasive jet machining, water jet machining, Electro-chemical machining and its processes, Electrical discharge machining, Laser Beam machining their mechanism of metal removal, process capability, effect of parameters on performance measures, economic consideration, application and limitations.						CO2
Unit 3	***Metal Cutting***						
	Metal Cutting, Cutting Tool Materials, Tool Wear and Cutting Fluids and Machine tool design, Automation, types of NC systems, MCU and other components, NC manual part programming, coordinate systems.						CO3
Unit 4	***Finite Element Methods***						
	Concept of the finite element method , coordinates and shape functions, Potential energy approach, Analysis of spring, Bar and truss elements, Stress analysis using Triangular element, Mesh Preparation, use of higher order elements, *S*olution of heat transfer problems using constant strain triangle and higher order elements.						CO4

Text Books	1. Arshimov & Alekree,"Metal cutting theory & Cutting tool design", MIR Publications 2. Pandey and shan. "Modern machining methods". TMH India 3. Chandrupatla T.R. and Belegundu A.D., "Introduction to finite Elements in Engineering", PHI Learning, New Delhi.	
Reference Books	1. Lindberg R.A, "Processes and Materials of Manufacture", Prentice Hall of India (P) Ltd.,1996 2.Serope Kalpak jain, "Manufacturing engineering and Technology", Edition III -Addision Wesley Publishing Co., 1995 3.William F. Hosford and Robert M. Caddel, "Metal forming", PrenticeHall Publishing Co., 1990.Shaw, "Principles of Metal cutting", Oxford I.B.H.	

Course Code	MED						
Course Title	**Additive Manufacturing**						
Course Outcomes	On the completion of the course the student will be able to: CO1: To provide an overview of Additive Manufacturing processes, systems and applications. CO2: Understand the overall principle and various processes for additive manufacturing. CO3: Select a particular additive manufacturing process based on the end application. CO4: Plan the steps in fabricating a given part using additive manufacturing.						
Examination Mode	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MTP	ESE	EPR	ABL/PBL
Weightage	10%	10%	25%	-	50%	-	5%
Syllabus							**CO Mapping**
Unit 1	***Introduction to Additive Manufacturing***						
	Evolution of AM/3D printing; Comparison with subtractive and forming processes; Advantages of AM; Classification of AM processes; Key steps in AM. Liquid State-based AM Processes: Stereo lithography – Process and working principle; Photopolymers; Photo polymerization, layering technology, Laser and Laser scanning; Micro stereolithography; Equipment and specifications; Applications, advantages, disadvantages, examples; Solid ground curing: Process, Working principle; Equipment and specifications; Applications, advantages, disadvantages, examples.						CO1
Unit 2	***Solid State-based AM Processes***						
	Fused Deposition Modeling – Process, working principle and materials; Equipment and specifications; Laminated object manufacturing – Process and working principle; Equipment and specifications; Applications, advantages, disadvantages, examples; Other solid-state processes – Ultrasonic consolidation, Gluing, Thermal bonding; Demonstration of equipment.						CO2
Unit 3	***Powder based AM Process***						
	Powder Bed Fusion Processes – Working principle and materials; Powder fusion mechanism and powder handling; Various LBF processes (principle, materials, applications and examples) – Selective laser Sintering, Electron Beam Melting, Laser Engineered Net Shaping, Binder Jetting and Direct Metal Deposition; Comparison between LBF processes; Materials-process-structure-property relationships; relative advantages and limitations.						CO3
Unit 4	***Applications of Additive Manufacturing***						
	Product development lifecycle applications – Rapid prototyping, concept models, visualization aids, replacement parts, tooling, jigs and fixtures, moulds and casting; Application sectors – aerospace, automobile, medical, jewelry, sports, electronics, food, architecture, construction and others.						CO4
Text Books	1. Sabrie Soloman, 3D Printing & Design, Khanna Book Publishing Company, New Delhi, 2020.						

Reference Books	1. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing", Springer, 2015 2. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications," World Scientific, 2015. 3. C.P Paul, A.N Junoop, "Additive Manufacturing: Principles, Technologies and Applications," McGrawHill, 2021.	
Online Resources:	1. https://onlinecourses.nptel.ac.in/noc21_me115/preview 2. https://onlinecourses.nptel.ac.in/noc20_mg70/preview	

Course Code	MED						
Course Title	**Composites Materials**						
Course Outcomes	On the completion of the course the student will be able to: CO1: To understand the various types of composites based on different base materials and reinforcements. CO2: To gain knowledge of Engineering Mechanics, Analysis, and Design of composites. CO3: To apply the various manufacturing processes to fabricate composites and then post processing and assembly. CO4: To evaluate the importance of quality assurance, their testing and finally engineering applications of fabricated composites.						
Examination Mode	Theory						
Assessment Tools	Written Quiz	Assignment/ Project Work	MSE	MTP	ESE	EPR	ABL/PBL
Weightage	10%	10%	25%	-	50%	-	5%
Syllabus							**CO Mapping**
Unit 1	***Introduction to Composites***						
	Constituent Materials.... Introduction to Constituent Materials. Introduction to Reinforcing Fibers, Glass Fibers, Carbon Fibers, Aramid Fibers.... Ceramic Fibers, Discontinuous Reinforcements for Metal-Matrix Composites, Continuous Fiber Reinforcements for Metal-Matrix Composite, Fabrics and Preforms, Braiding, Epoxy Resins, Polyester Resins, Bismaleimide Resins, Polyimide Resins, Phenolic Resins, Cyanate Ester Resins, Thermoplastic Resins, Molding Compounds, Metallic Matrices, Ceramic Matrices, Carbon Matrices, Interfaces and Interphases Lightweight Structural Cores, Bio-Based Resins and Natural Fibers						CO1
Unit 2	***Engineering Mechanics, Analysis, and Design***						
	Introduction to Engineering Mechanics, Analysis, and Design.... Micromechanics, Macro-mechanics Analysis of Laminate Properties, Characterizing Strength from a Structural Design Perspective, Fracture Mechanics of Composite Delamination, Hygrothermal Behavior, Fatigue and Life Prediction, Damping Properties, Bolted and Bonded Joints, Instability Considerations, Damage Tolerance, Out-of-Plane Analysis, Analysis of Sandwich Structures, Finite Element Analysis, Computer Programs, Testing and Analysis Correlation, Design Criteria, Design Allowables, Computer-Aided Design and Manufacturing, Design, Tooling, and Manufacturing Interaction, Cost Analysis Rapid Prototyping, Design Guidelines, Engineering Mechanics and Analysis of Metal-Matrix Composites, Fracture Analysis of Fiber-Reinforced Ceramic-Matrix Composites.						CO2
Unit 3	***Manufacturing Processes, Post-Processing and Assembly***						
	Introduction to Manufacturing of Polymer-Matrix Composites... Process Modeling Composite Tooling, Electroformed Nickel Tooling, Elastomeric Tooling, Open Molding: Hand Lay-Up and Spray-Up, Custom Sailing Yacht Design and Manufacture, Prepreg and Ply Cutting, Manual Prepreg Lay-Up, Fiber Placement, Automated Tape Laying, Curing, Resin Transfer Molding and Structural Reaction Injection, Molding, Vacuum Infusion, Compression Molding, Filament Winding, Pultrusion, Tube Rolling, Thermoplastic Composites Manufacturing. Processing of Metal-						CO3

	Matrix Composites, Processing of Ceramic-Matrix Composites, Processing of Carbon-Carbon Composites. **Post-Processing and Assembly**.... Introduction to Post-Processing and Assembly, Machining, Trimming, and Routing of Polymer-Matrix Composites, Secondary Adhesive Bonding of Polymer-Matrix Composites, Processing and Joining of Thermoplastic Composites, Hole Drilling in Polymer-Matrix Composites, Mechanical Fastener Selection Environmental Protection and Sealing, Extrusion of Particle-Reinforced Aluminum Composites, Post-Processing and Assembly of Ceramic-Matrix Composites.	
Unit 4	***Quality Assurance, Testing and Certification, Properties and applications of composites.***	
	Introduction to Quality Assurance, Resin Properties Analysis, Tooling and Assembly Quality Control, Reinforcing Material Lay-Up Quality Control, Cure Monitoring and Control, Nondestructive Testing, Quality Assurance of Metal-Matrix Composites. **Introduction to Testing and Certification**, Overview of Testing and Certification, Test Program Planning. Constituent Materials Testing, Lamina and Laminate Nonmechanical Testing, Lamina and Laminate Mechanical Testing Element and Subcomponent Testing, Full-Scale Structural Testing. **Properties and Performance of Polymer-Matrix Composites**, Properties of Metal-Matrix Composites Properties and Performance of Ceramic-Matrix and Carbon-Carbon Composites. **Introduction to Applications,** Automotive Applications, Automotive Applications of Metal-Matrix Composites, Space Applications, Aeronautical Applications of Metal-Matrix Composites, High-Temperature Applications. Aircraft Applications, Applications of Carbon-Carbon Composites 2 Sports and Recreation Equipment Applications, Thermal Management and Electronic Packaging Applications, Marine Applications, Civil Infrastructure Applications, Applications of Ceramic-Matrix Composites.	CO4
Text Books	1. Sanjay Mavinkere Rangappa, Suchart Siengchin "Tribology of Polymer Composites Characterization, Properties, and Applications. 2. Frank R. Jones "Composites Science, Technology, and Engineering" Cambridge University Press 2022 3. F.C. Campbell, "Manufacturing Processes for Advanced Composites", Elsevier Science.	
Reference Books	1. P.K. Mallick, "Fiber-Reinforced Composites: Materials, Manufacturing, and Design,", CRC Press. 2.Deborah D.L. Chung, "Composite Materials Science and Applications", Springer link. 3. Vijay Kumar Thakur, Manju Kumari Thakur "Hybrid Polymer Composite Materials Processing".	