Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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Course Structure and Contents

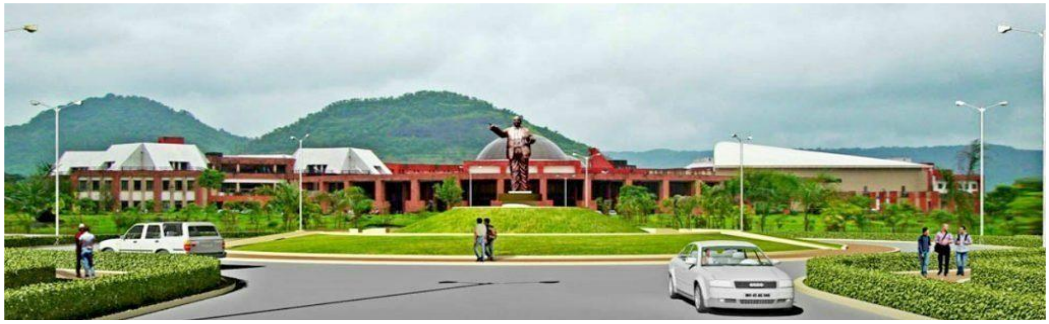
for

M.Tech. in Manufacturing Engg/Production/ Manufacturing Processes/Mechanical (Production Engg)

(For Affiliated Institutes Only)

Syllabus as per the guidelines of National Education Policy 2020

To be implemented from Academic Year 2024-25.



Vision

The vision of the Department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need-based research and extension activities.

Programme Educational Objectives (PEOs)

No.	PEO
PEO1	To train the students with in-depth and advanced knowledge to become professional and capable of identifying, analyzing and solving complex problems in the areas of design engineering.
PEO2	To enable post graduates to carry out innovative and independent research work, disseminate the knowledge in Academia/Industry/Research Organizations to develop systems and processes in the related field.
PEO3	To prepare the students to exhibit a high level of professionalism, integrity, effective communication skills and environmental and social responsibility.
PEO4	To provide an academic environment that gives adequate opportunity to the students to cultivate life-long independent learning abilities for their successful professional careers.

Programme Outcomes (POs)

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

No.	PO
PO1	Acquire, demonstrate and apply advanced knowledge in the area of manufacturing engineering.
PO2	Identify problems in the field of manufacturing engineering, formulate them and solve by using advanced techniques.
PO3	Conduct independent research and generate new knowledge for the benefit of community, society Industry and country.
PO4	Apply various numerical methods, advanced software and engineering tools to model, analyze and solve manufacturing engineering problems.
PO5	Work effectively in interdisciplinary teams for solving real life problems in the related field.
PO6	Apply engineering and scientific principles for the effective management of manufacturing systems.
PO7	Effectively communicate through technical reports, presentations and scientific publications with the engineering community as well as society at large.
PO8	Demonstrate traits of management in handling engineering projects, related finance, and coordinate with workforce towards achieving goals.
PO9	Demonstrate high level of professional and intellectual integrity, ethics of research and scholarly standards.
PO10	Examine critically the outcomes of one's actions and make corrective measures subsequently.
PO11	Demonstrate the ability to work in team in the laboratory in achieving multidisciplinary tasks required for the project.
PO12	Engage in life-long reflective and independent learning with high level of enthusiasm and commitment.

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Semester I

Sr. No	Course Type	Course Code	Course Name	Teaching Scheme			Credits	Examination Scheme				
				L	T	P		CA	Theory		PR/OR	Total
									MSE	ESE		
1	PCC	24AF2608PC101	Lasers in Manufacturing	3	--	--	3	20	20	60	-	100
2	PCC	24AF2608PC102	Advanced Materials and Processing	3	1	--	4	20	20	60	-	100
3	PCC	24AF2608PC103	Metal Casting Technology	3	1	--	4	20	20	60	-	100
4	PEC-I	24AF2608PE104A	Material Characterization Techniques	3	--	--	3	20	20	60	-	100
		24AF2608PE104B	Tribology									
		24AF2608PE104C	Nano Processing Techniques									
5	PEC-II	24AF2608PE105A	Abrasive Machining and Finishing Processes	3	--	--	3	20	20	60	-	100
		24AF2956PE105C	Finite Element Methods									
		24AF2608PE105B	Sustainable Manufacturing									
6	AEC	24AF2608AE106	Additive Manufacturing	3	--	--	3	20	20	60	-	100
7	PCC	24AF2608PCL107	Advanced Manufacturing Practices Laboratory	--	--	2	1	60	-	-	40	100
Total				18	2	2	21	180	120	360	40	700

Semester II

Sr. No	Course Type	Course Code	Course Name	Teaching Scheme			Credits	Examination Scheme				
				L	T	P		CA	Theory		PR/OR	Total
									MSE	ESE		
1	PCC	24AF2608PC201	Advanced Machining Technology	3	1	--	4	20	20	60	-	100
2	PCC	24AF2608PC202	Advances in Welding and Joining Technologies	3	1	--	4	20	20	60	-	100
3	PEC-III	24AF2956PE203A	Process Control Automation	3	--	--	3	20	20	60	-	100
		24AF2608PE203A	Computer Integrated Manufacturing									
		24AF2608PE203B	Composite Materials									
		24AF2608PE203C	CNC Technology									
4	PEC-IV	24AF2608PE204A	MEMS and Fabrication of Smart Materials	3	--	--	3	20	20	60	-	100
		24AF2608PE204B	Metrology and Computer Aided Inspection									
		24AF2608PE204C	Optimization Techniques in Manufacturing									
		24AF2608PE204D	Surface Engineering									
		24AF2608PE204E	Nanotechnology									
5	OEC-I	24AF2608OE205A	Mechatronics and Robotics	3	--	--	3	20	20	60	-	100
		24AF2608OE205B	Lean Manufacturing and Six Sigma									
		24AF2608OE205C	Quality system and Reliability Engineering									
		24AF2956OE205C	Engineering Economic Analysis									
		24AF2608OE205D	Applied Statistics									
6	MLC	24AF2608ML206	Research Methodology	3	--	--	3	20	20	60	-	100
7	AEC/VEC/ IKS	24AF2956IK206A	A. Indian Knowledge System: Concepts &Applications in Engineering	2	--	--	2	20	20	60	-	100
		24AF2956IK206 B	B. Indian Knowledge System: Humanities & Social Sciences									
		24AF2956IK206C	C. Ancient Indian Management									
Total				20	2	--	22	140	140	420	-	700

Semester III

Sr. No	Course Type	Course Code	Course Name	Teaching Scheme			Credits	Examination Scheme				
				L	T	P		CA	Theory		PR/OR	Total
									MSE	ESE		
1	SLC	24AF2914OE301A	Project Management (Self Study)	3	-	-	3	20	20	60	-	100
2	SLC	24AF2956PC303	Intellectual Property rights (Self Study)	3	-	-	3	20	20	60	-	100
3	AEC	24AF2608AE303	Seminar	-	-	2	2	50	-	-	50	100
4	VSEC	24AF2608VSE304	Dissertation Phase-I	-	-	-	10	50	-	-	50	100
Total				6-	-	--	18	140	40	120	100	400

Semester Iv

Sr. No	Course Type	Course Code	Course Name	Teaching Scheme		Credits		Examination Scheme				
				L	T	P	C	CA	Theory		PR/OR	Total
									MSE	ESE		
1	VSEC	24AF2608VSE401	Dissertation Phase-II	-	-	- -	20	100	-	-	-	100
Total				-	-	-	20	100	-	-	100	200

Credit Details

Semester I	Semester II	Semester III	Semester IV	Total Credits
21	22	18	20	81

Semester I

Lasers in Manufacturing

24AF2608PC101	Lasers in Manufacturing	PCC	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks		End-Sem Exam 60 Marks	Total 100 Marks

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

CO1	Explain the need and significance of Laser in manufacturing processes
CO2	Explain the mechanism of laser welding process
CO3	Explain the mechanism of surface modification using laser
CO4	Explain the additive manufacturing technique by using laser
CO5	Explain the laser assisted machining

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Lasers in manufacturing: Importance and application, Fundamentals of Laser Technology, Laser system: Construction and types, Principle of operation, Types of laser cutting and kerf geometry, Types of Lasers in material removal, process and performance parameters

Unit 2: **[8 Hours]**

Mechanisms of laser welding, effects of process parameters during laser welding and study of defects in weld beads, Material forming and fundamental of laser forming, process parameters and their effects on the performance of laser forming

Unit 3: **[7 Hours]**

Surface treatment and applications of lasers, laser surface hardening, laser surface alloying, Laser cladding

Unit 4: **[8 Hours]**

Additive manufacturing techniques, Laser scanning stereolithography, selective laser sintering and selective laser melting, process and performance parameters of laser based additive manufacturing techniques

Unit 5: **[8 Hours]**

Lasers in manufacturing automation, CNC for laser-based manufacturing, CAD for laser-based manufacturing, Laser assisted material forming, effect of coatings, 3D laser forming and micro forming.

References:

1. Steen, W. M., Laser Material Processing, Springer-Verlag, London, 2005.
2. Dahotre, N. and Samant, A., Laser Machining of Advanced Materials, CRC Press, London, 2015.
3. Joshi, S. N. and Dixit, U. S., Laser Based Manufacturing, Springer India, 2015.
4. Sugioka, K., Meunier, M., and Piqué, A., Laser Precision Microfabrication, Springer-Verlag, Berlin, Heidelberg, 2010.
5. Ion, J. C., Laser Processing of Engineering Materials, Elsevier, 2005

Advanced Materials and Processing

24AF2608PC102	Advanced Materials and Processing	PCC	3-1-0	4 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Compare the various non-conventional machining processes
CO2	Explain the need and significance of fine finishing processes
CO3	Select the appropriate forming process for the application
CO4	Select the appropriate micro-machining process for the application
CO5	Explain the need and significance of the fabrication of micro devices

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Advances in Non-Conventional Machining Processes [7 Hours]

A brief review of non-conventional machining processes, Analysis of mechanical, thermal and Electro-chemical type non-traditional machining processes. Tool design for selected non-traditional machining processes. Modelling and simulation of selected processes. A comparative study of various processes.

Unit 2: Advanced Fine Finishing Process: [8 Hours]

Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Process principle, process equipment; Analysis and modelling of finishing mechanism; parametric analysis; Applications.

Unit 3: Advances in Metal Forming **[8 Hours]**

Conventional processes-High Energy Rate Forming Techniques Explosive forming, electro hydraulic forming, magnetic pulse forming, superplastic forming, rubber forming, flow forming - Principles and process parameters- Advantages, Limitations and Applications. Overview of powder metal forming technique-Advantages-applications-Powder perform forging- Hot and cold Isostatic pressing powder rolling-Tooling and process parameters.

Unit 4: Micro-Machining **[8 Hours]**

Introduction to micromachining technologies, Micro-electro discharge Machining: Principles of micro-EDM, micro-EDM by Die-sinking and WEDG, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro-turning, micro-drilling and micro-milling, micro grinding, hybrid micro-machining method, on-line measurement by machine vision and integrated probe, Measuring Techniques in micro-machining, surface integrity and other related measurements.

Unit 5: Fabrication of Micro-Devices **[8 Hours]**

Semiconductors – films and film depurification – Oxidation – diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication

References :

1. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, M P GrooveWiley India.
2. Manufacturing Engineering and Technology, 4/e, Serope Kalpakjian, Steven R Schmid, Pearson Education.
3. Manufacturing Processes for Engineering Materials, 5/e, SeropeKalpakjian Pearson Education
4. Modeling of Metal Forming and Machining Processes by Finite Element and Soft Computing Methods, P M Dixit, U M Dixit Springer.
5. Modern Machining Processes, Pandey, P.C., and Shan, H.S.Tata McGraw-Hill Education
6. Micromachining of Engineering Materials J.A. McGeough. CRC Press.
7. Fundamentals of Microfabrication Mark Madou CRC Press.
8. Advance Method of Machining McGeough, J.A Springer.
9. Laser Processing of Materials: Fundamentals, Applications and Developments, Peter Schaaf Springer.

Metal Casting Technology

24AF2608PC103	Metal Casting Technology	PCC	3-1-0	4 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Select the appropriate casting process for the manufacturing of a given component
CO2	Design of gating and Risering system
CO3	Analyze the flow of molten metal in gating system
CO4	Explain the need and significance of special casting processes
CO5	Explain the inspection methods of various castings

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[10 Hours]**

Overview of different casting processes, Terminology and tools of sand moulding, Moulding sand and design, Moulding sand properties, Moulding sand property testing, Cores and core sand, Patterns and Allowances. Steps involved in making sand casting s, Design of Gating and Risering system, Sand Casting defects,

Unit 2: **[11 Hours]**

Melting, fluidity and solidification: Melting furnaces and practice, Treatment of molten metal, Fluidity of molten metal, solidification.

Unit 3: **[10Hours]**

Common cast alloys: Cast iron and steels, Aluminium and magnesium cast alloys, Copper, Zinc and Titanium cast alloys.

Unit 4: **[11Hours]**

Permanent mould and special casting processes: Die casting process, investment casting process, continuous casting process, Evaporative pattern casting and plaster moulding, vacuum sealed moulding and squeeze casting.

Unit 5: **[10Hours]**

Finishing design and environment: shakeout, fettling and finishing, Inspection, testing and quality, design consideration and Economics, Environment, Health and safety aspects.

References:

1. Fundamentals of Metal casting, Flinn,Addison Wesley.
2. Principles of Metal casting, Heine, Loper & Rosenthal, McGraw Hill.
3. Procuct Design and Process Engineering Practice, Niebel & Draper,Salmon & Simons, McGraw Hill Foundry, Issac Pitaman.

Material Characterization Techniques

24AF2608PE104A	Material Characterization Techniques	PEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks		End-Sem Exam 60 Marks	Total 100 Marks

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

CO1	Explain the need and significance of structural characterization
CO2	Explain the mechanism of characterization techniques
CO3	Describe the various thermal analysis techniques
CO4	Explain the need and significance of optical microscopy
CO5	Explain the need and significance of transmission electron microscopy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Structural characterization: phase transformation, electron microscopy, crystallography by using modern techniques. Properties: mechanical properties (like fatigue, fracture toughness, integrity assessment) relating to structure and processing, corrosion evaluation.

Unit 2: **[7 Hours]**

Characterization Techniques: X-ray diffraction, crystal structure and phase identification, residual stress measurement and other applications.

Unit 3: **[8 Hours]**

Outline of thermal analysis technique, description of DTA/DSC/TGA techniques and instrumentation, applications and case studies.

Unit 4: **[8 Hours]**

Optical microscopy light optics, microscope components, possibilities and limitations. Scanning Electron Microscopy Optics and performance of a SEM, image interpretation, crystallographic information in a SEM, analytical microscopy.

Unit 5: **[8Hours]**

Transmission Electron Microscopy Construction and operation of a TEM, Electron diffraction, image interpretation. IR- and Raman spectroscopy.

References:

1.G.E. Dieter, Mechanical Metallurgy, McGraw-Hill Book Co. (Third edition), 1988.

2.K. W. Andrews, Physical Metallurgy Techniques and Applications, Vol. 1 and 2, George Allen & Unwin, London, 1973

3. E. N. Kaufmann (Ed. in chief), Characterization of Materials, Vol 1. and 2, John Wiley and Sons Publication, New Jersey, 2003

4. Metals handbook, Vol. 9, Characterization of Materials, 10th Ed., American Society of Metals, Metals Park, OH, USA, 1986.

5. H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Settle, Instrumental Methods of Analysis, 6th Ed., CBS Publishers & Distributors, Delhi, 1986.

Tribology

24AF2608PE104B	Tribology	PEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks		End-Sem Exam 60 Marks	Total 100 Marks

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

CO1	Explain the need and significance of tribology
CO2	Explain the mechanism of wear
CO3	Explain the need and significance of lubricants
CO4	Compare the compressible and incompressible lubricants
CO5	Explain the role of lubricants in various types of bearings, gears

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Introduction to Tribology, History of Tribology, Interdisciplinary approach, Economic benefits, Causes of friction, adhesion theory, Junction growth theory, Laws of rolling friction, Friction instability.

Unit 2: **[7 Hours]**

Introduction to wear, adhesive wear, abrasive wear, corrosive wear, fretting wear, wear analysis.

Unit 3: **[8 Hours]**

Lubricants and Lubrication: Importance of lubrication, boundary lubrication, Mixed lubrication, full fluid film lubrication hydrodynamic, Elasto-hydrodynamic lubrication, types and properties of lubricants, lubricants additives.

Unit 4: **[8 Hours]**

Fluid film lubrication: fluid mechanics concepts, equation of continuity and motion, generalised Reynold's equation with compressible and incompressible lubricants.

Unit 5: **[8Hours]**

Applications of Tribology: Rolling contact bearings, gears, journal bearings.

References:

1. Dowson D, History of Tribology, Longman London, 1979.
2. Stachowiak G N,Batchelor A W and Stachowick G B "Experimental methods in Tribology", Tribology Series 44, Editor D Dowson, 2004.
3. Michael M Khonsari,Applied Tribology (Bearing Design and Lubrication),John Wiley & Sons, 2001.
4. Ludema K C, Friction, Wear, Lubrication:A textbook in Tribology, CRC Press, 2010.
5. Norton R L, Cam Design and Manufacturing Handbook, Industrial Press Inc., 2009.
6. http://auto.howstuffworks.com/power-window1.htm Accessed on 19th February 2013.
7. Stachowiak G W & Batchelor A W,Engineering Tribology, Third Edition,Elsevier Inc., 2005.
8. Shigley J E, Mischke C R, Mechanical Engineering Design, Tata McGraw-Hill Publishing Company Limited, 2003.

Nano Processing Techniques

24AF2608PE104C	Nano Processing Techniques	PEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks		End-Sem Exam 60 Marks	Total 100 Marks

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

CO1	Explain the ultra-precision machining processes
CO2	Explain the mechanism of Nano machining in atomic bit and cluster, Nano indentation and scratching
CO3	Explain the mechanism of diamond turning
CO4	Explain the need and significance of Nano mechanical processing
CO5	Explain the need and significance of Nano physical and electro-chemical processing

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Introduction: Definition of ultra-precision machining; Taniguchi curves of evolution of accuracy in the twentieth century; definition of Nanotechnology; Positional accuracy of today's manufacturing processes and equipment; Deviational and scattering errors in achieving nanometric resolution. Atomic-bit and atomic cluster processing methods: Nano-mechanical, nano-physical and nano-chemical and –electrochemical processes, their capabilities and advantages.

Unit 2: **[8 Hours]**

Mechanism of nano-mechanical processing of atomic clusters: Processing stress, breaking stress and processing energy density; Concept of size effect in mechanical processing; thresholds of specific energy; Nano-machining, abrasive and adhesive processing, theories of nanometric processing of ductile and brittle materials, and polymers; Failure and fracture under uniform and localized loading; Atomic-bit processing and lattice defect density, theories of nano-indentation and scratching.

Unit 3: **[8 Hours]**

Mechanism of nano-physical and -chemical processing of atomic-bits: Scanning tunnelling effect, directional photon, electron and ion beam processing, plasma surface processing, molecular beam processing; Principles of chemical and electro-chemical processing, equilibrium of chemical and electro-chemical reactions.

Unit 4: **[7Hours]**

Nano-processing systems (Nano-mechanical processing) - Diamond turning: Soft metal single-point diamond turning technology, the ultra-precision CNC machine, plane and spherical mirrors machining; Nano-grinding: technology and requirements, concept of critical depth of cut, size-effect in form and fine grinding, Elid grinding, Elastic emission grinding; mechano-chemical polishing of Si wafers, principles and models; Ultra-precision polishing: Principles of ultra-precision polishing of block gauges, balls and aspherical lenses.

Unit 5: **[8 Hours]**

Nano-processing systems (Nano-physical and –electrochemical processing): Photo beam processing: Thermal and chemical processes in photon beam ablation; Electron and ion beam processing: removal mechanism in electron and ion beam processing, abilities and limitations scanning tunneling microscope (STM) processing; Chemically reactive milling and etching processes, Chemically reactive deposition and consolidation, electrochemical machining and deposition processes. Nano-measuring systems: In-situ processes, mechanical and optical measuring systems, Scanning probe and image processing systems.

References:

1. N. Taniguchi, Nanotechnology: Integrated Processing Systems for Ultra-precision and Ultra-fine Products, Oxford University Press Inc., NY, 1996.
2. J. McGeough, Micromachining of Engineering Materials, Marcel Dekker, Inc., NY, 2002.
3. M. C. Shaw, Principles of Abrasive Processing, Oxford: Clarendon Press, 1996.

Abrasive Machining and Finishing Processes

24AF2608PE105A	Abrasive Machining and Finishing Processes	PEC-II	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the need and significance of sustainable machining processes
CO2	Explain the Lapping and super finishing processes
CO3	Explain the need and significance of non-conventional machining processes
CO4	Describe the need and significance of abrasive flow machining
CO5	Explain the magneto rheological finishing processes

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents –

Unit 1: **[8 Hours]**

Introduction to abrasive machining and finishing processes, grinding process, grinding fluids and its additives, grinding fluids and its emissions, sustainable grinding process: biodegradation of grinding fluids, MQL in grinding process

Unit 2: **[8 Hours]**

Honing process, Lapping process, Super finishing and sand blasting, vibratory bowl finishing, rotary barrel finishing or tumbling, drag finishing, Ice bonded abrasive finishing, pitch polishing, pad polishing

Unit 3: **[8 Hours]**

Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining, EDM, wire EDM, Electric discharge grinding, Electric discharge diamond grinding, Elastic emission machining, Powder mixed EDM, Electro-chemical machining.

Unit 4: **[8 Hours]**

Abrasive flow machining, Magnetic field assisted abrasive finishing, Magnetic abrasive finishing, Magnetic abrasive deburring, Magnetic float finishing**.**

Unit 5: **[8 Hours]**

Magneto rheological finishing, Magneto rheological Abrasive flow finishing, Rotational Magneto rheological Abrasive flow finishing.

References:

1. M. C. Shaw, Principles of Abrasive Processing, Oxford University Press, 1996

2. V. K. Jain, Micro-manufacturing Processes, CRC Press, 2012

3. V. K. Jain, Nanofinishing science and Technology, Basic and Advanced finishing and Polishing Processes, CRC Press, 2016

4. J. A. Mc Geough, Advanced Methods of Machining, Springer Science and Business Media, 1988

5. G. K. Lal, Introduction to Machining Science, New Age International Publishers, 2007

6. A. Ghosh and A. K. Malik, Manufacturing Science, East West Press, 2010

7. V. P. Astakhov and S. Joksch, Metalworking fluids for cutting and grinding, Woodhead Publishing, 2012

Finite Element Methods

24AF2956PE105C	Finite Element Methods	PEC-II	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks		End-Sem Exam 60 Marks	Total 100 Marks

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

CO1	Explain the significance of Finite element method
CO2	Solve the structural problems using Finite element method
CO3	Solve the structural problems using Finite element method
CO4	Derive element stiffness matrix by various methods
CO5	Solve 3D problems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

1-D Problems: Introduction to structural analysis and FEM, Introduction to approximate solutions and FEM, summary of linear elastic mechanics.

Unit 2: **[7 Hours]**

1-D Problems: Principles of linear elastic mechanics, principles of virtual displacements and minimum potential energy, Rayleigh Ritz method, exact v/s approximate solution, beam elements**.**

Unit 3: **[8 Hours]**

2-D Problems: Plane stress and plane strain conditions, triangular elements, constant strain triangle, linear strain triangle, Boundary conditions, body forces and stress recovery, quadrilateral elements.

Unit 4: **[8 Hours]**

2-D Problems: Lagrange and Serendipity shape functions, iso parametric formulation, numerical integration, modeling with iso parametric elements, requirements for convergence, patch test, nonconforming elements, reduced integration.

Unit 5: **[8 Hours]**

3-D Problems: Axisymmetric solids, governing equations, axisymmetric elements and their applications, mixed formulations, bending of flat plates (Kirchhoff Theory), continuity requirements and boundary conditions. 3-D Problems: Discrete Kirchhoff's elements, thick plate elements, plate bending applications, shells as assemblage of flat plates, finite element formulation for dynamic problems, mass properties, introduction to elastic stability for frames and plates.

References:

1. R. D. Cook, Concepts and Applications of Finite Element Analysis; John Wiley and Sons, second edition, 1981.
2. C.S. Krishnamurti, Finite element method; Tata Mc-Graw Hill Publication.
3. K.J. Bathe, Finite Element Method and Procedures; Prentice hall, 1996.
4. Tirupathi, R., and Chandrupatla, Finite Elements in Engineering; PHI Publication, New Delhi.
5. Bruce Irons and Soharab Ahmed, Techniques of Finite Elements; John Wiley and Sons, New York.
6. K.J. Bathe, Finite Element Method; Prentice Hall, 1987.
7. O.P., Goptha, Finite and Boundary Element Methods in Engineering; Oxford and IBH.

Sustainable Manufacturing

24AF2608PE105B	Sustainable Manufacturing	PEC-II	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the need and significance of sustainable manufacturing processes
CO2	Explain the life cycle assessment
CO3	Explain the need and significance of green manufacturing modelling
CO4	Explain the role of renewable energy in green machining
CO5	Apply the sustainability and green manufacturing system in developing a smart factory

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Basics of production, Sustainability and manufacturing, Introduction to simulation, basic statistical concept for sustainable manufacturing analysis

Unit 2: **[8 Hours]**

Life cycle assessment, Life cycle assessment elements, Life cycle assessment procedure, sustainability framework, basic modelling functions for factory simulation

Unit 3: **[7 Hours]**

Green manufacturing modelling: metrics for green manufacturing, Indices for green manufacturing, Developing green manufacturing system, Productivity and sustainability, green manufacturing techniques.

Unit 4: **[8 Hours]**

Basics of production, Sustainability and manufacturing, Introduction to simulation, basic statistical concept for sustainable manufacturing analysis

Unit 5: **[8 Hours]**

Developing a smart factory, Sustainability and green manufacturing system.

References:

1. Sustainability in Manufacturing Enterprises by Ibrahim Garbie, Springer publication

2. Green manufacturing processing and systems by J. Paulo Davim, springer publication 2013

3. Sustainable Manufacturing, by Rainer Stark, Günther Seliger, Jérémy Bonvoisin, Springer publication, 2017

Additive Manufacturing

24AF2608AE106	Additive Manufacturing	AEC	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks		End-Sem Exam 60 Marks	Total 100 Marks

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

CO1	Explain the need and significance of additive manufacturing
CO2	Prepare the CAD model
CO3	Select the appropriate additive manufacturing process for the application
CO4	Explain the powder based additive manufacturing techniques
CO5	Explain the Rapid manufacturing process

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Introduction Overview - Historical Development - Need – Classification - Additive Manufacturing Technology in product development – Materials for Additive Manufacturing Technology – Traditional v/s Additive Manufacturing – Tooling – Benefits and Applications.

Unit 2: **[7 Hours]**

Geometric Model & Reverse Engineering Basic Concept – Digitization Techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology, CAD model preparation – Interface Formats - Part Orientation and support generation – Model Slicing – Tool path generation – Software for Additive Manufacturing Technology: RP software.

Unit 3: **[8 Hours]**

Liquid Based and Solid Based Additive Manufacturing Systems Classification – Liquid based system – Stereolithography Apparatus (SLA) – Principle, process, advantages and applications – Solid based system – Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing.

Unit 4: **[8 Hours]**

Powder Based Additive Manufacturing Systems Selective Laser Sintering (SLS) – Principle, process, advantages and applications – Three-Dimensional Printing – Principle, process, advantages and applications – Laser Engineered Net Shaping (LENS), Electron Beam Melting – Shape deposition manufacturing, Laser deposition, Lamination, Electro-optical sintering.

Unit 5: **[8 Hours]**

Rapid Casting and Segmental Object Manufacturing, Visible Slicing Implementation Rapid casting using wax patterns, acrylic patterns, dense polystyrene patterns - Expanded polystyrene process – Rapid manufacturing of metallic objects. Medical and Bio-Additive Manufacturing Customized implants and prosthesis, Design and production, Bio-Additive Manufacturing – Computer Aided Tissue Engineering (CATE) – Case Studies.

References:

1. Chua C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010.
2. Gephardt A., “Rapid Prototyping”, Hanser Gardener Publications, 2003. 3. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2007.

Advanced Manufacturing Practices Laboratory

24AF2608PCL107	Advanced Manufacturing Practices Laboratory	PCC	0-0-2	1 Credits
Examination Schedule				
Continuous Assessment 60 Marks		PR/OR 40 Marks		Total 100 Marks

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

CO1	Measure the cutting forces in turning and milling process
CO2	Modelling of machine components using software like ANSYS, L DYNA
CO3	Optimize the machining processes like EDM, Wire EDM,
CO4	Design a pneumatic circuit for the given application
CO5	Inspect the given component by using CMM

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Perform the following experiments (Any four)

Experiment No. 1: Cutting force determination using force dynamometer in CNC Milling Operation.

Experiment No. 2: Cutting force determination using force dynamometer in CNC Turning Operation.

Experiment No. 3: Experimental study in micromachining using photo chemical machining.

Experiment No. 4: Solid modeling of structural components using modeling software.

Experiment No. 5: Solid modeling of machine components using modeling software.

Experiment No. 6: Analysis of machine components using ANSYS, LSDyna etc. software.

Experiment No. 7: Use of statistical quality control software for process optimization.

Experiment No. 8: Study of EDM/Wire EDM for metal machining.

Experiment No. 9: Metal casting simulation using PROCAST.

Experiment No. 10: Sequencing of cylinders using pneumatic trainer kit.

Experiment No. 11: Modeling of component and determination of mass properties.

Experiment No. 12: Inspection of an engineering component using CMM.

Experiment No. 13: Simulation of robo

Semester-II

Advanced Machining Technology

24AF2608PC201	Advanced Machining Technology	PCC	3-1-0	4 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks		End-Sem Exam 60 Marks	Total 100 Marks

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

CO1	Explain the non-conventional mechanical processes
CO2	Describe the abrasive finishing processes
CO3	Explain the chemical non-conventional machining processes
CO4	Explain the non-conventional machining processes based on thermal energy
CO5	Describe the non-conventional machining processes based on electrical energy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[10Hours]**

Mechanical Processes: Ultrasonic Machining - Water Jet Machining - Abrasive Jet Machining - Abrasive Water Jet Machining - Ice Jet Machining

Unit 2: **[11 Hours]**

Abrasive flow finishing (AFF), Magnetorheological finishing (MRF), Magnetic Abrasive Finishing, Electro chemical grinding, working principle, merits, demerits and applications.

Unit 3: **[10 Hours]**

Chemical and Electrochemical Processes: Chemical Milling - Photochemical Milling - Electropolishing - Electrochemical Machining - Electrochemical Drilling - Shaped Tube Electrolytic Machining – working principle, merits, demerits and applications.

Unit 4: **[11 Hours]**

Thermal Processes: Electric Discharge Machining - Laser Beam Machining - Electron Beam Machining - Plasma Beam Machining - Ion Beam Machining – working principle, merits, demerits and applications.

Unit 5: **[10 Hours]**

Hybrid Processes: Electrochemical Grinding, Honing, Superfinishing and Buffing - Ultrasonic Assisted ECM – Electro erosion Dissolution Machining - Abrasive Electro discharge Machining - EDM with Ultrasonic Assistance - Laser Assisted Machining – working principle, merits, demerits and applications

References:

1. Bhattacharya "Metal Cutting Theory and Practice", New Central Book Agency (p) Ltd., Calcutta1984.
2. Boothroyd .D.G. and Knight. W.A "Fundamentals of Machining and Machine tools", Marcel Dekker, New York, 1989.
3. Hassan Abdel – Gawad El-Hofy "Advanced Machining Processes", McGraw, New York, 2005.
4. Jain, V.K "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2007.
5. Kalpakjian, S "Manufacturing Process for Engineering Materials", MA:Addison-Wesley, 1997.
6. Brown, J "Advanced Machining Technology Handbook", New York: McGraw-Hill, 1998.
7. Xichun Luo and Yi Qin "Hybrid Machining: Theory, Methods, and Case Studies", Academic press, 2018.

Advances in Welding and Joining Technologies

24AF2608PC202	Advances in Welding and Joining Technologies	PCC	3-1-0	4 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Select the appropriate welding process for the application
CO2	Select the appropriate input parameters for enhancing weld quality
CO3	Describe the melted and heat affected zone of a metal
CO4	Describe the welding defects
CO5	Analyze the stresses in welding structures

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[10 Hours]**

Welding processes classification, arc welding processes- solid state welding processes, plasma arc welding and ultrasonic welding - Resistance welding process- different types weld joints, welding positions. Brazing, soldering and adhesive bonding, process principles & applications.

Unit 2: **[11 Hours]**

Electron beam welding - Laser beam welding - Hybrid welding - CMT welding – SpinArc GMAW – Tandem GMAW - Activated TIG welding- Hot wire TIG welding- Diffusion bonding - Weld Surfacing & cladding.

Unit 3: **[10 Hours]**

Friction Surfacing, Friction stir spot welding, Explosive Welding, Welding of Al and Mg based alloys - Dissimilar welding of Non-ferrous alloys - Friction welding with Cu interlayer.

Unit 4: **[11 Hours]**

Magnetically impelled arc butt (MIAB) welding - Under water welding -Welding of Cu, Al, Ti and Ni alloys – Dissimilar welding of ferrous alloys - processes, difficulties, microstructures, defects and remedial measures -Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control.

Unit 5: **[10 Hours]**

Heat transfer and solidification - Analysis of stresses in welded structures – Pre and post welding heat treatments – Weld joint design – welding defects-Inspection & testing of weld joints - Safety aspects in welding.

References:

1. Dr.R.S.Parmer "Welding processes and Technology" Khanna Publishers.
2. H.S.Bawa "Manufacturing Technology-I" Tata McGraw Hill Publishers New Delhi, 2007.
3. S.V.Nadkami, Modem Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd.
4. Cornu.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers,1994.
5. Lancaster.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980
6. Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
7. P .L. Jain “Principles of foundry Technology" Tata Mc Graw Hill Publishers.

Process Control Automation

24AF2956PE203A	Process Control Automation	PEC-III	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Student will able to explain Process Modeling
CO2	Student will able to design PID controller for given application
CO3	Student will able to solve problems related to frequency response analysis
CO4	Student will able to simulate control system for given application
CO5	Student will able to use tools and techniques for advances process control
CO6	Students will be able to discuss issue related to plant control

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents –

Unit I: Process Modeling **[8 Hours]**

Introduction to Process control and process instrumentation-Hierarchies in process control systems-Theoretical models-Transfer function-State space models-Time series models-Development of empirical models from process data-chemical reactor modeling-. Analysis using software's.

Unit 2: Feedback and Feed forward Control **[8 Hours]**

Feedback controllers-PID design, tuning, trouble shooting, Cascade control, Selective control loop, Ratio control.

Unit 3: Frequency Response **[7 Hours]**

Control system design based on Frequency response Analysis, Direct digital design, Feed- forward and Dr. Babasaheb Ambedkar Technological University, Lonere ratio control. State feedback control. LQR problem, Pole placement.

Unit 4: Software Simulations of control system **[8 Hours]**

Simulation using softwares, Control system instrumentation, Control valves, Codes and standards, Preparation of P& I Diagrams.

Unit 5: Advanced process control **[8 Hours]**

Multi-loop and multivariable control, Process Interactions, Singular value analysis, tuning of multi loop PID control systems, decoupling control, strategies for reducing control loop interactions, Real-time optimization.

Unit 6: Plant Control **[8 Hours]**

Model predictive control-Batch Process control-Plant-wide control & monitoring- Plant wide control design- Instrumentation for process monitoring-Statistical process control- Introduction to Fuzzy Logic in Process Control-Introduction to OPC.Introduction to environmental issues and sustainable development relating to process industries. Comparison of performance different types of control with examples on software.

References:

1. Seborg, D.E., T.F. Edgar, and D.A. Mellichamp, Process Dynamics and Control, John Wiley , 2004

2. Johnson D Curtis, Instrumentation Technology, (7th Edition) Prentice Hall India, 2002. 3.Bob Connel,Process Instrumentation Applications Manual, McGrawHill, 1996.

4. Edgar, T.F. & D.M. Himmelblau, Optimization of Chemical Processes, McGrawHill Book Co, 1988.

5. Macari Emir Joe and Michael F Saunders, Environmental Quality Innovative Technologies

Computer Integrated Manufacturing

24AF2608PE203A	Computer Integrated Manufacturing	PEC-III	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the role of computer in manufacturing processes
CO2	Explain the analysis of transfer line and flow line
CO3	Explain the need and significance of transformation, scaling, rotation
CO4	Explain the importance of CAPP
CO5	Explain the IOT applications in manufacturing

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Introduction to CIM **[8 Hours]**

Computers and manufacturing systems, Computer numerical control, Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process,

Unit 2: Automated Production Lines and Assembly Systems: **[7 Hours]**

Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems.

Unit 3: CAD and Computer Graphics Software: **[8 Hours]**

The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry. Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations

Computerized Manufacture Planning and Control System: Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control

Unit 4: Flexible Manufacturing Systems **[8 Hour]**

Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture.

Line Balancing: Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method.

Unit 5: Robot Technology: **[8 Hours]**

Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: Material handling, processing and assembly and inspection.

Future of Automated Factory: Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems.

References:

1. Chang, T.C. and Wysk, R.A., 1997. Computer-aided manufacturing. Prentice Hall PTR.

2. Xu, X., 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control. Information Science Reference.

3. Groover, M.P., 2007. Automation, production systems, and computer-integrated manufacturing. Prentice Hall Press.

4. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann..

5. "CAD/CAM" by Ibrahim Zeid, Tata McGraw Hill.

6. Industry 4.0: The Industrial Internet of Things, Apress, 2017, by Alasdair Gilchrist

Composite Materials

24AF2608PE203B	Composite Materials	PEC-III	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the properties of composite materials
CO2	Explain the maximum stress and strain theory
CO3	Analyze the thermal effects on composite material
CO4	Explain the behaviour of composite plate in bidirectional compression
CO5	Explain the short fibre composites

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[7 Hours]**

Basics of composite materials, different types of fibers, properties of single layer continuous fiber composites, strength of single layer continuous fiber composites, concept of tensor, general anisotropic material, specially orthotropic material, stress and strain transformation, strain-displacement relations, relations for stress and strain along thickness of laminate, force and moment resultant,

Unit 2: **[8 Hours]**

quasi isotropic laminates, Maximum stress and strain theory, importance of sign of shear stress, failure initiation in composite laminate, progressive failure of laminae in a laminate, governing equations for composite plates, force equilibrium in z direction, Equilibrium equations for composite plates

Unit3: **[8 Hours]**

Thermal effects in composite laminates, finite rectangular plate, different boundary conditions in finite rectangular plate,

Unit 4: **[8 Hours]**

Anticlastic curvature, principle of virtual work, buckling of composite plates, composite plate under bidirectional compression

Unit 5: **[8 Hours]**

Shear buckling in rectangular plate, introduction to short fiber composites, Theories of stress transfer. Modulus of short fiber composites

References:

1. Principles of composite material mechanics by Ronald Gibson

2. An introduction to composite materials by T.W. Clyne and D. Hull

3. Composite Materials: Functional Materials for modern technologies by Deborah D. L. Chung, springer publications

CNC Technology

24AF2608PE203C	CNC Technology	PEC-III	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the significance of CNC machines
CO2	Explain the significance of the feedback devices in CNC machines
CO3	Describe the features of CNC system
CO4	Develop CNC part program for a given component
CO5	Simulate CNC part program on simulation software

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents –

Unit 1: **[8 Hours]**

Introduction to Numerical Control in computer aided manufacturing, components of a CNC system, types of CNC systems, open loop and closed loop control systems.

Unit 2: **[8 Hours]**

Drives and controls, interpolators, feedback devices, CNC machine constructional features.

Unit 3: **[7 Hours]**

CNC design considerations, CNC turret punch press, tooling for CNC, APC, ATC, CNC machine accessories, advanced features of CNC system

Unit 4: **[8 Hours]**

CNC part programming for turning and milling, post processors, CNC part programming with CAD-CAM.

Unit 5: **[8 Hours]**

Conversational and graphics based software, solids based part programming, free form surface machining, simulation and verification of CNC programs, computer assisted part programming. Maintenance and installation of CNC systems, utilization of CNC machines.

References:

1. S. Krar, A. Gill., CNC Technology and Programming, McGraw-Hill Publishing Co., 1990.
2. P. J. Amic, Computer Numerical Control Programming, Prentice Hall, 1996.
3. K. J.Astrom, B. Wittenmark, Adaptive Control (2nd Ed.), Addison-Wesley, 1994
4. CNC Machining Handbook by Alan Overby
5. CNC programming for machining by J. Paulo Davim, Springer publication

MEMS and Fabrication of Smart Materials

24AF2608PE204A	MEMS and Fabrication of Smart Materials	PEC-IV	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the need and significance of MEMS
CO2	Explain the application of MEMS
CO3	Explain the Processing and characteristics of Shape memory alloys
CO4	Explain the need and significance of ER and MR fluids
CO5	Explain the need and significance of Piezoelectric materials

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1:Introduction **[8 Hours]**

MEMS: History of MEMS, Intrinsic Characteristics, Devices: Sensors andActuators. Microfabrication: Photolithography, Thermal oxidation, Thin film deposition, etching types, Doping, Dicing, Bonding. Microelectronics fabrication process flow, Silicon based, Process selection and design.

Unit 2:Polymer MEMS & Microfluidics **[8 Hours]**

Introduction, Polymers in MEMS(Polyimide, SU-8,LCP,PDMS,PMMA,Parylene,Others) Applications(Acceleration, Pressure, Flow, Tactile sensors).Motivation for micro fluidics, Biological Concepts, Design and Fabrication of Selective components. Channels and Valves

Unit 3: Closed loop and Open loop Smart Structures **[8 Hours]**

Applications of Smart structures, piezoelectric properties. Inchworm Linear motor, Shape memory alloys, Shape memory effect-Application, Processing and characteristics.

Unit 4: Electro rheological and Magneto rheological Fluids [8 Hours]

Mechanisms and Properties, Characteristics, Fluid composition and behaviour, Discovery and Early developments, Summary of material properties. Applications of ER and MR fluids (Clutches, Dampers, others)

Unit5: Piezoelectric Sensing and Actuation. **[7 Hours]**

Introduction, Cantilever Piezoelectric actuator model, Properties of Piezoelectric materials, Applications. Magnetic Actuation: Concepts and Principles, Magnetization and Nomenclatures, Fabrication and case studies, Comparison of major sensing and actuation methods.

References:

1.“Smart Structures –Analysis and Design”, A.V.Srin ivasan, Cambridge University Press, New York, 2001, (ISBN:0521650267).

2. “Smart Materials and Structures”, M.V.Gandhi and B.S.Thompson Chapmen & Hall, London, 1992 (ISBN:0412370107)

3. “Foundation of MEMS, by Chang Liu. Pearson Educa tion. (ISBN:9788131764756)

Metrology and Computer Aided Inspection

24AF2608PE204B	Metrology and Computer Aided Inspection	PEC-IV	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Select the appropriate instrument for high precision measurement
CO2	Explain the need and significance of calibration process for the instruments
CO3	Explain the gauging principle
CO4	Explain the use and significance of non-contact measuring instrument
CO5	Explain the need and significance of in process gauging

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[7 Hours]**

Metrological concepts, Abbe's principle, need for high precision measurements, problems associated with high precision measurements.

Unit 2: **[8Hours]**

Standards for length measurement, shop floor standards and their calibration, light interference, method of coincidence.

Unit 3: **[8 Hours]**

Slip gauge calibration, measurement errors, various tolerances, and their specifications, gauging principles.

Unit 4: **[8 Hours]**

Selective assembly, comparators, angular measurements, principles and instruments, gear and thread measurements. Surface and form metrology, computer aided metrology, principles and interfacing, software metrology, laser metrology, CMM, types, probes used applications. Non-contact CMM using electro-optical sensors for dimensional metrology, non-contact sensors for surface finish measurements, image processing and its applications in metrology.

Unit 5: **[8 Hours]**

Advanced Metrology : Advanced measuring machines, Laser vision, In-process gauging, 3D metrology, metrology Softwares, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies**.**

References:

1. D. J. Whitehouse, Handbook of Surface Metrology, Inst. of Physics Bristol and Philadelphia, 1994.

2. R. K. Jain, Engineering Metrology, Khanna Publishers, 2000.

3. Galleyer and Shotbolt, Metrology for Engineers, ELBS, 1998.

Optimization Techniques in Manufacturing

24AF2608PE204C	Optimization Techniques in Manufacturing	PEC-IV	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Classify different optimization and evolutionary algorithms
CO2	Select the appropriate single variable optimization technique for the application
CO3	Apply the non-linear programming for the optimization of the process
CO4	Apply the dynamic programming for the optimization of the process
CO5	Apply the neural network and fuzzy system for the optimization of the process

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Intelligent Optimization Techniques Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO).

Unit 2: **[8 Hours]**

Single Variable Optimization Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

Unit 3: **[8 Hours]**

Non-linear programming: Introduction Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming Separable programming Stochastic programming Geometric programming

Unit 4: **[8 Hours]**

Integer programming and dynamic programming and network techniques: Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

Unit 5: **[8 Hours]**

Advances in simulation, Neural Network and Fuzzy systems, Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

References:

1. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997

2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997

3. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994

4. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi 1 – 2005

5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

6. Genetic Algorithms in Search, Optimization, and Machine Learning - David Goldberg:

7. Fuzzy Logic with Engineering Applications by Timothy J Ross

Surface Engineering

24AF2608PE204D	Surface Engineering	PEC-IV	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Explain the need and significance of surface engineering
CO2	Describe various surface cleaning and modification techniques.
CO3	Explain the concept of surface integrity
CO4	Compare surface coating techniques
CO5	Select appropriate coating for the application

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: **[8 Hours]**

Introduction Definition, Significance, Role of surface Engineering in creating high performance product, Functional characteristics of a surface, Nature of surfaces: Deformed layer, Beilby layer, chemically reacted layer, Physisorbed layer, Chemisorbed layer; Classification of Surface Engineering Techniques

Unit 2: **[7 Hours]**

Surface Preparation Techniques Factors affecting selection of cleaning process, Significance of surface preparation, Classification of cleaning processes, Chemical cleaning processes; Mechanical Processes; Substrate considerations, Surface contaminants or soils: Various types and their removal, Tests for cleanliness.

Unit 3: **[8 Hours]**

Surface Integrity Definition, Importance, Surface alterations, Factors in Surface Integrity: Visual, Dimensional Residual stress, Tribological, Metallurgical; Measuring Surface Integrity effects: Minimum and Standard data set, Macroscopic and microscopic examination.

Unit 4: **[8 Hours]**

Surface Modification Techniques Classification, Thermal treatments: Laser and electron beam hardening, Mechanical treatments: Short peening: Peening action, surface coverage and peening intensity, Types and sizes of media, Control of process variables, equipment; Ion Implantation: Basic Principle, Advantages and disadvantages, equipment.

Unit 5: **[8 Hours]**

Surface Coating Techniques Thermal Spraying Types and applications; Chemical Vapour Deposition: Principles, Reactions, Types and applications; Physical Vapour Deposition: Basic principle, Evaporation, Sputtering, Ion Plating, Applications; Electroplating: Principle of working and applications; Types of Coatings: Hard, Soft, Single layer, Multi-layer. Characterization of Coatings Physical characteristics and their measurements: Coating thickness, Surface Morphology and Microstructure. Mechanical properties and their Measurements: Hardness, Adhesion, Friction and Wear.

References:

1. ASM Handbook, Volume 5: Surface Engineering, ASM International
2. Budinski K. G.; Surface Engineering for Wear Resistance; Prentice Hall
3. Bukowski T. and T. Wierschon; Surface Engineering of Metals: Principles, Equipment, Technologies; CRC Press
4. Bhushan B. and Gupta B. K.; Handbook of Tribology: Materials, Coatings, and Surface Treatments; McGraw Hill
5. ASM Handbook, Volume 16: Machining, ASM International

Nanotechnology

24AF2608PE204E	Nanotechnology	PEC-IV	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the need and significance of nanotechnology
CO2	Explain the Nano defects in crystals
CO3	Explain the need and significance of Nano structuring
CO4	Explain the need, significance and applications of Nano materials structuring
CO5	Explain the various characterization techniques for the nano materials

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit1:Overview of Nanotechnology **[8 Hours]**

Definition – historical development – properties, design and fabrication Nano systems, working principle, applications and advantages of nano system. Nanomaterial's ordered oxides Nano arrays potential health effects.

Unit 2: Nano defects, nano particles and Nano layers **[8 Hours]**

Nano defects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties

Unit 3: Nano structuring **[8 Hours]**

Nano photolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nano-polishing of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nano arrays –Near-Field Optics - case studies and Trends

Unit 4: Science and Synthesis of Nano Materials [7Hours]

Classification of nano structures – Effects of nano scale dimensions on various properties structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source-based production techniques – Gaseous carbon source-based production techniques – Diamond like carbon coating. Top down and bottom up processes.

Unit 5: Characterization of Nano Materials [8 Hours]

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunnelling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

References:

1. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003

2. Fahrner W.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.

3. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN: 8493-9138-5

4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003

5.. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN:470-85106-6

6.. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.

7. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013, ISBN: 978-93-82291-39-8

Mechatronics and Robotics

24AF2608OE205A	Mechatronics and Robotics	OEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Explain the role of mechatronics in manufacturing processes
CO2	Explain the need and significance of drives
CO3	Explain the need and significance of robotics in manufacturing
CO4	Develop an equations for motions
CO5	Explain the applications of robots

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Introduction **[7 Hours]**

Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach. Review of fundamentals of electronics. Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs.

Unit 2: Drives **[8 Hours]**

Stepper motors, servo drives. Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Description of PID controllers.

Unit 3: Introduction to robotics **[8 Hours]**

Brief history, types, classification and usage and the science and technology of robots. Kinematics of robot: direct and inverse kinematics problems and workspace, inverse kinematics solution for the general 6R manipulator, redundant and over-constrained manipulators.

Unit 4: Velocity and static analysis of manipulators

Linear and angular velocity, Jacobian of manipulators, singularity, static analysis. Dynamics of manipulators: formulation of equations of motion, recursive dynamics, and generation of symbolic equations of motion by a computer simulations of robots using software and commercially available packages.

Unit 5: Planning and control **[8 Hours]**

Trajectory planning, position control, force control, hybrid control Industrial and medical robotics: application in manufacturing processes, e.g. casting, welding, painting, machining, heat treatment and nuclear power stations, etc; medical robots: image guided surgical robots, radiotherapy, cancer treatment, etc; Advanced topics in robotics: Modelling and control of flexible manipulators, wheeled mobile robots, bipeds, etc.

References:

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. R. Iserman, Mechatronic Systems: Fundamentals, Springer, 1st Edition, 2005
3. Musa Jouaneh, Fundamentals of Mechatronics, 1st Edition, Cengage Learning,2012.
4. S. K. Saha, ―Introduction to Robotics‖, Tata McGraw-Hill Publishing Company Ltd. (2008).
5 S. B. Niku, ―Introduction to Robotics–Analysis Systems, Applications‖, Pearson Education (2001).
6. . A. Ghosal, Robotics: ―Fundamental Concepts and Analysis‖, Oxford University Press (2008).
9. Pires, ―Industrial Robot Programming–Building Application for the Factories of the Future‖, Springer (2007).

Lean Manufacturing and Six Sigma

24AF2608OE205B	Lean Manufacturing and Six Sigma	OEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Explain the need and significance of lean manufacturing concept
CO2	Explain the need and significance of total productive maintenance
CO3	Explain the concept of process capability
CO4	Explain the need and significance of six sigma concept
CO5	Explain the laws of lean six sigma

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Lean Manufacturing **[8 Hours]**

Introduction - History of Lean – Toyota Production System comparison to other methods - The 7 Wastes, their causes and the effects – An overview of Lean Principles / concepts / tools - Stockless Production. Tools of Lean Manufacturing Continuous Flow -Continuous Flow Manufacturing and Standard Work Flow - 5S and Pull Systems (Kanban and ConWIP systems) Error Proofing and Set-up Reduction.

Unit 2: Total Productive Maintenance (TPM) **[7 Hours]**

Kaizen Event examples. Value Stream Mapping Current state and Future State-Ford Production Systems. Building a Current State Map (principles, concepts, loops, and methodology) - Application to the factory Simulation scenario.

Unit 3: Key issues in building the Future State Map **[8 Hours]**

Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop - Example of completed Future State Maps Factory simulation – Implementation of lean practices – Best Practices in Lean Manufacturing.

Unit 4: Six Sigma Fundamentals **[8 Hours]**

Selecting Projects – Six Sigma Statistics - Measurement System Analysis - Process Capability - DMAIC – Define, Measure, Analyze, Improve, Control.

Unit 5: Base Decisions on Data and Facts **[8 Hours]**

Five Laws of Lean Six Sigma - Case Studies. Ergonomics-as enabler of lean manufacturing, Ergonomic consideration at work, Principles related to: the use of human body, the arrangement of workplace, the design of tools and Equipment's

References:

1. James P. Womack, Daniel T. Jones, and Daniel Roos, "The Machine that Changed the World: the Story of Lean Production", Simon & Schuster, 1996.
2. Jeffrey K. Liker, "Becoming Lean", Industrial Engineering and Management Press, 1997.
3. James P. Womack and Daniel T. Jones, "Lean Thinking", Free Press-Business and Economics, 2003.
4. Rother M. and Shook J., "Learning to See", The Lean Enterprise Institute, Brookline,2003.
5. George, Michael. L. "Lean six sigma: combining six sigma quality with lean speed", Tata McGraw Hill Education, New Delhi, 2002.
6. Larson, Alan,"Demystifying six sigma : a company-wide approach to continuous improvement", Jaico, Mumbai, 2007.
7. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.

Quality System and Reliability Engineering

24AF2608OE205C	Quality System and Reliability Engineering	OEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Explain the various approaches of quality
CO2	Explain the need and significance of TQM
CO3	Describe the various quality improvement processes
CO4	Select appropriate statistical process for quality control of the given part
CO5	Explain the need and significance of reliability

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Introduction **[8 Hours]**

New culture of TQM, TQM axioms, consequences of total quality managing, cost of total quality, valuable tools for quality, the Japanese factor. The Deming Approach to management: Historical background, Deming's fourteen points, for management, deadly sins & diseases, implementing the Deming's philosophy. Juran on Quality: Developing a habit of quality, Juran`s quality trilogy, the universal breakthrough sequence, Juran Vs Deming. Crosby & the Quality Treatment: Crosby diagnosis of a troubled company, Crosby's quality vaccine, Crosby's absolutes for quality management, Crosby's fourteen steps for quality improvement.

Unit 2: Basic Techniques for Statistical Analysis **[8 Hours]**

Introduction, measures of central tendency & dispersion, confidence intervals, hypothesis testing, frequency distributions & histograms, probability distributions, measuring linear associations. Design & Analysis of Experiments: Introductions, factorial experiments, aliasing, constructing fractional designs, analysis of variance.

Unit 3: Supporting of Quality Improvement Processes **[8 Hours]**

Affinity diagram, bar chart, block diagram brain storming, cause and effect analysis, control charts, cost benefit analysis, customer supplier relationship check list, decision analysis, flow charts, force field analysis, line graph/run charts, pareto analysis, quality costing, quality function development (QFD), quality project approach & problem solving process, risk analysis scatter diagrams, Weibull analysis, 6 Sigma.

Unit 4: Statistical Process Control **[7 Hours]**

Introduction, data collection plan, variables charts, attributes, interpreting the control charts. Taguchi's Approach to Experimental Design & Offline Quality Control: Introduction, background to the method, Taguchi's recommended design techniques, from Deming to Taguchi & vice-versa.

Unit 5: Reliability **[8 Hours]**

Introduction, life cycle curves & probability distribution in modeling reliability, system reliability, operating characteristic curves, reliability and life testing plans.

References:

1. N.Logothetis, Managing for Total Quality From Deming to Taguchi and SPC , Prentice Hall of India, New Delhi, 2005.
2. R.F.Lochner&J.E.Matar, Designing for Quality, Chapman & Hall, 2001.
3. A.Mitra , Fundamental of Quality Control & Improvement , Prentice Hall of India, New Delhi, 2nd edition, 2003.
4. A. Zaidi, SPC:Concepts, Methodologies and Tools, Prentice Hall of India, New Delhi, 1995.

Engineering Economic Analysis

24AF2956OE205C	Engineering Economic Analysis	OEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

Pre-Requisites:

Course Outcomes: At the end of the course the student will be able to:

CO1	Study the steps in economic analysis and the various costs involved
CO2	Understand time value of money and cash flows
CO3	Explain the various cash flows of economic analysis
CO4	Discuss the aspects of money management
CO5	Analyse the worth of investments using different methods

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1	1						1
CO2	1	1	1	1	1					1	1	1
CO3	1	1	1	2	1					1	1	1
CO4	1	1		1	1					1		1
CO5												

Course Contents-

Unit-1: Introduction **[8 Hours]**

Project Life Cycle Stages, What is a Feasibility Study?, Feasibility Study Process, What is Engineering Economic Analysis?, Engineering Economic Analysis Steps, Cost Terminologies.

Unit-2: **Time Value of Money** [7 Hours]

Time Value of Money Concept, Cash Flow Diagrams, Interest and Interest Rate, Types of Interest Rates

Unit-3: Economic Equivalence **[8 Hours]**

Economic Equivalence Concept, Uniform (Equal) Series Cash Flow, Uneven (Irregular) Series Cash Flow, Arithmetic (Linear) Gradient Series Cash Flow, Geometric Gradient Series Cash Flow, Composite Cash Flow

Unit-4: Money Management **[8 Hours]**

Money Management Aspects, Multiple Compounding Periods Concept, Nominal and Effective Interest Rates, Changing Interest Rates, Amortized Loans, Add-On Loans, Inflation, Customized Loans.

Unit-5: Measuring Worth Investments **[8 Hours]**

Project Cash Flow, Measuring Worth of Investments Methods, Payback Period Method, Net Present Worth Method, Net Future Worth Method, Net Annual Worth Method, Internal Rate of Return (IRR) Method, IRR Direct Solution Method, IRR Trial and Error Method, External Rate of Return Method.Types of Projects/Investments, Independent and Mutually Exclusive Projects, Ranking Approach, Time Span Equalizing.

Texts/References:

1. Engineering Economic Analysis, Donald G. Newman, Jerome P. Lavalle and Ted G. Eschenbach, Oxford University Press, 12th Edition.

Applied Statistics

24AF2608OE205D	Applied Statistics	OEC-I	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Find the expressions for the characteristic function of a random variable and verify its properties.
CO2	To recognize and evaluate the relationship between two quantitative variables through simple linear correlation and regression.
CO3	Apply the different testing tools like t-test, F-test, chi-square test to analyze the real life problems
CO4	Find the standard deviation of a experimental data set
CO5	Create the robust design of experiment

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Probability and random variables **[8 Hours]**

Probability – Axioms of probability Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

Unit 2:Two dimensional random variables **[8 Hours]**

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

Unit3: Testing of Hypothesis **[8 Hours]**

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit

Unit 4: Estimation Theory **[7 Hours]**

Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

Unit 5: Design of Experiments **[8 Hours]**

Completely randomized design – Randomized block design Latin square design 2 2 Factorial design.

References:

1. Devore, J. L., “Probability and Statistics for Engineering and Sciences”, 8 th Edition, Cengage Learning, 2014.

2. Gupta S.C. and Kapoor V.K.,” Fundamentals of Mathematical Statistics”, 12th Edition, Sultan and Sons, New Delhi, 2020.

3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund’s Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.

4. Rice, J. A., "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.

5. Ross, S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.

Research Methodology

24AF2608ML206	Research Methodology	MLC	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the need and significance of research
CO2	Explain the need for the research design
CO3	Explain the role of hypothesis testing in research work
CO4	Explain the significance of data collection
CO5	Explain the need of interpretation

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Research Methodology [8 Hours]

Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, an illustration.

Unit 2: Reviewing the literature [8 Hours]

Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design,

Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Unit 3: Design of Sampling **[8Hours]**

Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Unit 4: Testing of Hypotheses **[7 Hours]**

Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi-Square Tests.

Unit 5: Interpretation and Report Writing **[8 Hours]**

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Report

References:

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.
2. Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), Ranjit Kumar, SAGE Publications, 3rd Edition, 2011.
3. Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
4. Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

Indian Knowledge System

24AF2956IK206A	Indian Knowledge System-Concepts and Applications in Engineering	IKS	2-0-0	2 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit-1:- Indian Knowledge System **[5Hours]**

An Introduction: 1. What is IKS? 2. Why do we need IKS? 3. Organization of IKS 4. Historicity of IKS 5. Some salient aspects of IKS

The Vedic Corpus: 1. Introduction to Vedas 2. A synopsis of the four Vedas 3. Sub- classification of Vedas 4. Messages in Vedas 5. Introduction to Vedāṅgas 6. Prologue on Śikṣā and Vyākaraṇa 7. Basics of Nirukta and Chandas 8. Introduction to Kalpa and Jyotiṣa 9. Vedic Life: A Distinctive Features

Unit-2:- Number Systems and Units of Measurement **[5Hours]**

1. Number systems in India - Historical evidence 2. Salient aspects of Indian Mathematics 3. Bhūta-Saṃkhyā system 4. Kaṭapayādi system 5. Measurements for time, distance, and weight 6. Piṅgala and the Binary system

Mathematics: 1. Introduction to Indian Mathematics 2. Unique aspects of India Mathematics 3. Indian Mathematicians and their Contributions 4. Algebra 5. Geometry 6. Trigonometry 7. Binary mathematics and combinatorial problems in Chandaḥ Śāstra 8. Magic squares in India

Astronomy: 1. Introduction to Indian astronomy 2. Indian contributions in astronomy 3. The celestial coordinate system 4. Elements of the Indian calendar 5. Notion of years and months 6. Pañcāṅga – The Indian calendar system 7. Astronomical Instruments (Yantras) 8. Jantar Mantar of Rājā Jai Singh Sawai**.**

Unit3 :-Engineering and Technology [5Hours]

Metals and Metalworking: 1. Wootz Steel: The rise and fall of a great Indian technology 2. The Indian S & T heritage 3. Mining and ore extraction 4. Metals and metalworking technology 5. Iron and steel in India 6. Lost wax casting of idols and artefacts 7. Apparatuses used for extraction of metallic components

Engineering and Technology: Other applications: 1. Irrigation systems and practices in South India 2. Literary sources for science and technology 3. Physical structures in India 4. Irrigation and water management 5. Dyes and painting technology 6. The art of making perfumes 7. Surgical techniques 8. Shipbuilding 9. Sixty-four art forms (64 Kalās) 10. Status of Indigenous S & T**.**

Unit-4:- Town Planning and Architecture: [5Hours]

1. Perspective of Arthaśāstra on town planning 2. Vāstu- śāstra – The science of architecture 3. Eight limbs of Vāstu 4. Town planning 5. Temples in India: marvelous stone architecture for eternity 6. Temple architecture in India 7. Iconography.

Knowledge Framework and classifications: 1. Indian scheme of knowledge 2. The knowledge triangle 3. Prameya – A vaiśeṣikan approach to physical reality 4. Dravyas – the constituents of the physical reality 5. Attributes – the properties of substances and Action – the driver of conjunction and disjunction 6. Sāmānya, viśēṣa, samavāya 7. Pramāṇa – the means of valid knowledge 8. Saṃśaya – ambiguities in existing knowledge 9. Framework for establishing valid knowledge 10. Deductive or inductive logic framework 11. Potential fallacies in the reasoning process 12. Siddhānta: established tenets in a field of study

Unit-5:- Linguistics [6Hours]

1. Introduction to Linguistics 2. Aṣṭādhyāyī 3. Phonetics 4. Word generation 5. Computational aspects 6. Mnemonics 7. Recursive operations 8. Rule based operations 9. Sentence formation 10. Verbs and prefixes 11. Role of Sanskrit in natural language processing.

TEXTBOOKS /REFERENCES:

1.Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.For additional Reading Pride of India: A Glimpse into India‟s Scientific Heritage, Samskrita Bharati, New Delhi.

2.Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.

3.Bag, A.K. (1979). Mathematics in Ancient and Medieval India, Chaukhamba Orientalia, New Delhi.

4.Datta, B. and Singh, A.N. (1962). History of Hindu Mathematics: Parts I and II, Asia Publishing House, Mumbai.

5.Kak, S.C. (1987). "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), pp. 205–221.

6.Subbarayappa, B.V. and Sarma, K.V. (1985). Indian Astronomy: A Source Book, Nehru Centre, Mumbai.

7.Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi.

8.Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.

9.Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.

10.Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.

Indian Knowledge System

24AF2956IK206B	Indian Knowledge System-Concepts and Applications in Engineering	IKS	2-0-0	2 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit-1:- **Indian Knowledge System** **[5Hours]**

An Introduction: 1. What is IKS? 2. Why do we need IKS? 3. Organization of IKS 4. Historicity of IKS 5. Some salient aspects of IKS The Vedic Corpus: 1. Introduction to Vedas 2. A synopsis of the four Vedas 3. Sub- classification of Vedas 4. Messages in Vedas 5. Introduction to Vedāṅgas 6. Prologue on Śikṣā and Vyākaraṇa 7. Basics of Nirukta and Chandas 8. Introduction to Kalpa and Jyotiṣa 9. Vedic Life: A Distinctive Features

Unit-2 :- **Philosophical Systems** **[5Hours]**

1. An introduction to philosophical systems 2. Development of philosophy 3.Unique features of philosophy 4.Sāṅkhya approach of philosophy 5.Introduction to Yoga 6.Tenet of Nyāya philosophy 7. Principles of Vaiśeṣika 8.Doctrine of Pūrva-Mīmāṃsā Darśana 9. Thesis of Vedānta and synopsis of Advaita 10. Philosophy of Viśiṣṭādvaita 11. Ideology of Dvaita 12. Tenets of Jaina 13. Doctrine of Buddhism 14. Notions of Cārvāka Wisdom through the Ages:

1. Gateways of ancestral wisdoms 2. Introduction to Purāṇa 3. The Purāṇic repository 4. Issues of interest in Purāṇas 5. Introduction to Itihāsas 6. Key messages in Itihāsas 7. Wisdom through Nīti-śāstras 8. Wisdom through Subhāṣita

Unit-3:- Knowledge Framework and classifications [5Hours]

1. Indian scheme of knowledge 2. The knowledge triangle 3. Prameya – A vaiśeṣikan approach to physical reality 4. Dravyas – the constituents of the physical reality 5. Attributes – the properties of substances and Action – the driver of conjunction and disjunction 6. Sāmānya, viśēṣa, samavāya 7. Pramāṇa – the means of valid knowledge 8. Saṃśaya – ambiguities in existing knowledge 9. Framework for establishing valid knowledge 10. Deductive or inductive logic framework 11. Potential fallacies in the reasoning process 12. Siddhānta: established tenets in a field of study

Linguistics: 1. Introduction to Linguistics 2. Aṣṭādhyāyī 3. Phonetics 4. Word generation 5. Computational aspects 6. Mnemonics 7. Recursive operations 8. Rule based operations 9. Sentence formation 10. Verbs and prefixes 11. Role of Sanskrit in natural language processing

Unit-4:- Number Systems and Units of Measurement [5Hours]

1. Number systems in India – Historical evidence 2. Salient aspects of Indian Mathematics 3. Bhūta-Saṃkhyā system 4. Kaṭapayādi system 5. Measurements for time, distance, and weight 6. Piṅgala and the Binary system Health Wellness and Psychology: 1. Introduction to health 2. Āyurveda: approach to health 3. Sapta-dhātavaḥ: seven-tissues 4. Role of agni in health 5. Tri-doṣas 6. Āyurveda: definition of health 7. Psychological aspects of health 8. Disease management elements 9. Dinacaryā: daily regimen for health & wellness 10. Importance of sleep 11. Food intake methods and drugs 12. Approach to lead a healthy life 13. Indian approach to psychology 14. The tri guṇa system & holistic picture of the individual 15. The Nature of Consciousness 16. Consciousness studies and issues

Unit-5:- Town Planning and Architecture [6Hours]

1. Perspective of Arthaśāstra on town planning

2.Vāstu-śāstra – The science of architecture 3. Eight limbs of Vāstu 4. Town planning

5. Temples in India: marvelous stone architecture for eternity 6. Temple architecture in India 7. Iconography Governance and Public Administration: 1. Introduction to raja dharma 2. Arthaśāstra: a historical perspective 3. Elements of a kauṭilyan state 4. The king & the amātya 5. Janapada & durga 6. Treasury and the State Economy (Kośa) 7. Danda 8. Mitra 9. The Administrative Setup 10. Relevance of Arthaśāstra 11. Public Administration in Epics

TEXTBOOKS /REFERENCES:

1.Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N.
(2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

Additional Readings:

1.Pride of India: A Glimpse into India‟s Scientific Heritage, Samskrita Bharati, New Delhi.

2.Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.

3.Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.

4.Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.

5.Dasgupta,S. (1975). A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi.

6.PLofker, K. (1963). Mathematics in India, Princeton University Press, New Jeresy, USA"

Indian Knowledge System

24AF2956IK206C	Indian Knowledge System-Concepts and Applications in Engineering	IKS	2-0-0	2 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents

Unit-1 Introduction

Understanding management: Defining management,Natureof management, Management: Science or art?

Ancient Indian Management

Unit-2

Management Perspective of Ancient Indian Literature: What is Jain Literature?, What is Vedantic Literature?, code of conduct in vedantic literature, code of conduct in Jain Literature, Four pillars of human labor in ancient Vedantic and Jain Literature Management lessons from Mahabharata

Unit-3

Management in Bhagavad Gita:

Introduction to Gita, Management Lessons from Bhagavad Gita, Unit-4

Management lessons from Ramayana:

Introduction to Ramayana, Management Lessons from Ramayana

Unit-5 Ancient Indian Economics:

Kautilya‟s economics Mahavira‟s economics

TEXTBOOKS / REFERENCES:

1.Indian Management by Subhash Sharma. New Age International (P) Limited Publishers< New Delhi ISBN: 978-93-89802-41-2

2.Management Concepts - In Ancient Indian Psycho-Philosophic Thought &Thier Significance for Present Day Organisations by Ipshita Bansal, Popular Book Depo

3.In Indian Logic: Modern Management Philosophies as derived from Ancient Indian Philosophies, by Aparna Singh.

Project Management

24AF2608SL301A	Project Management	SLC	0-0-0	3 Credits
Examination Schedule				
Continuous Assessment 40 Marks		End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Appraise the selection and initiation of individual projects and its portfolios in an enterprise.
CO2	Analyze the project planning activities that will predict project costs, time schedule, and quality.
CO3	Develop processes for successful resource allocation, communication, and risk management.
CO4	Evaluate effective project execution and control techniques that results in successful project completion
CO5	Select the project based on TOPSIS and SAW

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents –

Unit 1: Overview of Project Management: Verities of project, Project Features, Project Life Cycle – S-Curve, J-C Project Selection: Project Identification and Screening – New ideas, Vision, Long-term objectives, SWOT Analysis (Strength, Weakness, Opportunities, Threats). Project Appraisal – Market Appraisal, Technical Appraisal, Economic Appraisal, Ecological Appraisal, and Financial Appraisal – Payback, Net Present Value (NPV), Internal Rate of Returns (IRR).

Project Selection – Decision Matrix, Technique for Order Preference using Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW)[8 Hours]).

Unit 2: Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization. Work definition: Defining work content, Time Estimation Method, Project

Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

Unit 3: Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Leveling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.

Unit 4: Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management. Post-Project Analysis.

Unit 5: Project Execution: Monitoring control cycle, Earned Value Analysis (EVA), Project Contro Physical control,Humancontrol, financial control.

Organizational and Behavioural Issues: Organizational Structure, Selection-Project Manager, Leadership Motivation, Communication, Risk Management.

Project Termination: Extinction, Addition, Integration, Starvation.

References:

1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India
2. Lock, Gower, Project Management Handbook

Intellectual Property Rights

24AF2956PC303	Intellectual Property Rights	SLC	0-0-0	3 Credits
Examination Schedule				
Continuous Assessment 40 Marks		End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Explain the importance of IPR
CO2	Explain the need and significance of copyrights
CO3	Explain the need and significance of Patents
CO4	Explain the various types of Acts with respect to IPR
CO5	Explain the significance of Trade Mark Act

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents -

Unit 1: Introduction to IPR; Overview & Importance; IPR in India and IPR abroad; Patents; their definition; granting; infringement ;searching & filing; Utility Models an introduction;

Unit 2: Copyrights ; their definition; granting; infringement ;searching & filing, distinction between related rights and copy rights; Trademarks ,role in commerce ,importance , protection, registration; domain names; Copyright Act,1957

Unit 3: Industrial Designs ; Design Patents; scope; protection; filing infringement; difference between Designs & Patents', The Designs Act, 2000, Patents Act, 1970, Geographical indications , international protection; Plant varieties; breeder's rights, protection; biotechnology& research and rights managements; licensing, commercialization; ; legal issues, enforcement ;Case studies in IPR

Unit 4: Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, , , The Geographical Indications of Goods (Registration and Protection) Act1999, , The Protection of Plant Varieties and Farmers‟ Rights Act, 2001, The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992.

Unit 5: Trade Mark Act, 1999, TRADE MARKS— Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties

References:

1. Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body under an Act of Parliament, September2013.
2. Prabuddha Ganguli, IPR published by Tata McGraw Hill 2001

Seminar

24AF2608AE303	Seminar	AEC	0-0-2	2 Credits
Examination Schedule				
Continuous Assessment 40 Marks	End-Sem Exam 60 Marks	Total 100 Marks		

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

CO1	Identify and compare technical and practical issues related to the area of course specialization.
CO2	Prepare a well-organized report employing elements of technical writing and critical thinking.
CO3	Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												

Objective: To assess the debating capability of the student to present a technical topic. Also, to impart training to a student to face audience and present ideas and thus creating self-esteem, self-confidence and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest from Manufacturing Systems Management related topics preferably from outside the M.Tech syllabus or an extension of syllabus and give a seminar on that topic for about 30 minutes. The Seminar can also be a case study from a manufacturing organization. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

Dr. Babasaheb Ambedkar Technological University, Lonere

Program: M.Tech Manufacturing

Dissertation Phase I

24AF2608VSE304	Dissertation Phase I	VSEC		10 Credits
Examination Schedule				
Continuous Assessment 40 Marks		PR/OR 60 Marks		Total 100 Marks

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

CO1	Identify methods and materials to carry out experiments/develop code.
CO2	Reorganize the procedures with a concern for society, environment and ethics.
CO3	Analyze and discuss the results to draw valid conclusions.
CO4	Prepare a report as per recommended format and defend the work
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Dissertation phase I can be a design project, experimental project, computer simulation project or an empirical study involving data collection and analysis from manufacturing organisations. The topic should be on Manufacturing Systems Management or any of the topics related with manufacturing stream. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute. If found essential they may be permitted to continue their project outside the parent institute subject to the conditions of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members. The student is

required to undertake the masters research project phase-I during the third semester and the same is continued in the 4th semester (Phase-II). Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

Semester IV

Dissertation Phase II

24AF2608VSE401	Dissertation Phase II	VSEC	0-0-0	20 Credits
Examination Schedule				
Continuous Assessment 100 Marks		PR/OR 100 Marks		Total 200 Marks

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

CO1	Identify methods and materials to carry out experiments/develop code
CO2	Reorganize the procedures with a concern for society, environment and ethics.
CO3	Analyze and discuss the results to draw valid conclusions.
CO4	Prepare a report as per recommended format and defend the work
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Objectives: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Dissertation phase II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.