DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING
GURU GHASIDAS VISHWAVIDYALAYA
BILASPUR (C.G.)
(A Central University)
Koni, Bilaspur-495009, C.G (India)

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM (CBCS)

MASTER OF TECHNOLOGY
IN
CAD-CAM AND ROBOTICS

COURSE STRUCTURE AND SYLLABI

M. Tech. Regular Two-Year Degree Program
(Effective from 17.06.2022 for the academic year 2021-22)

DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING
SCHOOL OF STUDIES IN ENGINEERING & TECHNOLOGY, GGV,
BILASPUR, C.G. (INDIA)

DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING
SCHOOL OF ENGINEERING & TECHNOLOGY, GGV, BILASPUR, C.G. (INDIA)

SCHEME OF EXAMINATION

M.TECH. CAD-CAM and ROBOTICS

M.Tech. I-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	IPPATT1	Computer Aided Design	3	0	0	40	60	100	3
2.	IPPATT2	Fundamentals of Robotics	3	0	0	40	60	100	3
3.	IPPATP1 IPPATP2 IPPATP3	Elective – I 1. Computer Integrated Manufacturing 2. Rapid Prototyping and Tooling 3. Supply chain management	3	0	0	40	60	100	3
4.	IPPATP4 IPPATP5 IPPATP6	Elective – II 1. Advanced Manufacturing Processes 2. Mechanics of Sheet Metal Forming 3. Micro-manufacturing	3	0	0	40	60	100	3
5.	IPPATP7 IPPATP8 IPPATP9	Elective – III 1. Modeling & Simulation 2. Theory of Vibration 3. Artificial Intelligence	3	0	0	40	60	100	3
6.	IPPATC1	Research Methodology & IPR	2	0	0	-	50	50	2
7.	IPPALT1	CAD-CAM lab	0	0	4	30	20	50	2
Total			17	0	4	230	370	600	19

M.TECH. CAD-CAM and ROBOTICS

M.Tech. II-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	IPPBTT1	Finite Element Analysis	3	0	0	40	60	100	3
2.	IPPBTT2	Robotics and Control	3	0	0	40	60	100	3
3.	IPPBTP1 IPPBTP2 IPPBTP3	Elective – IV 1. Green Manufacturing 2. Advance Operation Research 3. Total Quality Management	3	0	0	40	60	100	3
4.	IPPBTP4 IPPBTP5 IPPBTP6	Elective – V 1. Mechanics of Composite Material 2. Smart Materials and Applications 3. Mechatronics in Manufacturing Systems	3	0	0	40	60	100	3
5.	IPPBTO1 IPPBTO2 IPPBTO3 IPPBTO4 IPPBTO5 IPPBTO6 IPPBTO7 IPPBTO8	Open Elective 1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy 7. Production Management 8. MOOCs	3	0	0	40	60	100	3
6.	IPPBTX1 IPPBTX2 IPPBTX3 IPPBTX4 IPPBTX5 IPPBTX6 IPPBTX7 IPPBTX8	Audit Course-I 1. English for Research Paper Writing 2. Disaster Management 3. Sanskrit for Technical Knowledge 4. Value Education 5. Constitution of India 6. Pedagogy Studies 7. Stress Management by Yoga 8. Personality Development through Life Enlightenment Skills.	2	0	0	40	60	100	2
7.	IPPBPT1	Mini Project	0	0	4	30	20	50	2
8.	IPPBLT1	Robotics lab	0	0	4	30	20	50	2
Total			17	0	08	300	400	700	21

Note: Under MOOCs the students have to opt any subject other than Industrial & Production Engineering from NPTEL/UGC SWAYAM.

M.TECH. CAD-CAM and ROBOTICS

M.Tech. III-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	IPPCPT1	Dissertation Stage–I	0	0	28	100	100	200	14
Total			0	0	28	100	100	200	14

M.TECH. CAD-CAM and ROBOTICS

M.Tech. IV-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	IPPDPT1	Dissertation Stage–II	0	0	32	100	200	300	16
Total			0	0	32	100	200	300	16

Total Credits for the Program = 19 + 21 +14 +16 = 70

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPATT1	Computer Aided Design	3	0	0	40	60	100	3

IPPATT1 COMPUTER AIDED DESIGN

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand the basic fundamentals of computer graphics used in CAD hardware and software.
2. Impart knowledge of various algorithms used to generate analytical, synthetic and parametric curves.
3. Introduce the new design concept and optimization technique to generate surface and solid in CAD.

COURSE CONTENTS

Module 1

Basics of CAD, CAD system evaluation criteria, principle of computer graphics, hardware and software, color management, raster graphics, graphics standard, graphic primitives, lines, circle and ellipse algorithms, windowing, clipping and view port, software documentations.

Module 2

Coordinate systems, fundamental of transformations, concatenation and homogeneous transformations, two- and three-dimensional geometric transformations, projections.

Module 3

Basics of curves, parametric and non-parametric curves, analytical and synthetic curves, continuity of curves, mathematical representation of curves, wireframe models, wire frame entities, parametric representation of synthetic curves, hermite cubic splines, bezier curves, b-splines, rational curves. curve manipulation: displaying, segmentation, trimming, intersection.

Module 4

Mathematical representation of surfaces, surface model, surface entities, surface representation, parametric representation of surfaces, plane surface, rule surface, surface of revolution, tabulated cylinder. hermite bi-cubic surface, bezier surface, b-spline surface, COONs surface, blending surface, sculptured surface.

Module 5

Mathematical representation of solid, solid modeling, solid representation, boundary representation (B-rep), constructive solid geometry (CSG), analytic solid modeling, introduction of finite element method (FEM). one dimensional FEM.

Text Books & References:

1. Zeid I. & Subramanian R. S., CAD/CAM Theory and practice, Tata McGraw Hill.
2. Zeid I., Mastering CAD/CAM, McGraw Hill International.

3. Groover M.P. & Zimmers E., CAD/CAM: Computer-Aided Design and Manufacturing,
4. Pearson Education.
5. Rao P. N., CAD/CAM Principles and Applications, Tata McGraw Hill.
6. Alavala, CAD/CAM Concepts and Applications, Prentice Hall of India.
7. Krishnamurthy N., Introduction to Computer Graphics, Tata McGraw Hill.
8. Newman W.M. & Sproull R.F., Principles of Interactive Computer Graphics, Tata McGraw Hill.

COURSE OUTCOMES:

After successful completion of this course students are able to;

CO1: Analyze the engineering design process and its role in graphic communication process.

CO2: Generate and interpret engineering technical drawings of parts and assemblies according to engineering design standards.

CO3: Use CAD software to generate a computer model and technical drawing for a simple, well-defined part or assembly.

CO4: Fluent application of engineering techniques, tools and resources Effective oral and written communication in professional and lay domains.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	-	-	-	-	-	-	2	3	3	3
CO2	3	1	3	3	1	-	-	-	-	-	-	3	2	3	2
CO3	3	2	2	2	1	-	-	-	-	-	-	2	3	2	3
CO4	3	2	2	3	1	-	-	-	-	-	-	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPATT2	**Fundamentals of Robotics**	**3**	**0**	**0**	**40**	**60**	**100**	**3**

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Learn about the robotics world and its applications in real world environment.
2. Understand the concepts of various drives, actuator, sensors systems and machine vision used in robots.
3. Impart knowledge of the gripper and control aspects of the robotic systems.
4. Introduce the artificial intelligence and machine learning used in the robotics.
5. Introduce the working principles of intelligent autonomous vehicle (IAV) and quad-rotors unmanned aerial vehicle (QUAV).

COURSE CONTENTS

Module 1

Introduction: Historical background of robotics, development and laws of robotics, robot anatomy, specifications and configurations, classifications, resolution, accuracy, repeatability, dexterity, compliance, remote centre compliance (RCC) device etc. automation concept and need, automation in production system, principles and strategies of automation, basic elements of an automated system, advanced automation functions, levels of automations, introduction to automation productivity, introduction and challenges of various robots, typical industrial and non industrial applications of robots.

Module 2

Robot drives and actuators: Introduction of robot drives and actuators, functions and classification of drive and actuator systems, open loop and closed loop control used in drives and actuators, selection of drives and actuators, various motors used in robotics, pneumatic drives, hydraulic drives, arrangement of actuators in robots, modelling of robot servos, error response, feedback and feed forward compensations, computer controlled servo systems, selection of robot drives and actuators, advantages and disadvantages of different type of drives and actuators.

Module 3

Sensors and vision system: Introduction to sensors and transducers, characteristicsand requirements of sensing devices, active and passive sensors, internal and external state sensor, classifications and functions of sensors and transducers, position and velocity sensors, proximity sensors, force and torque sensors, camera sensor, robot guidance with vision system, vision system devices, image acquisition, masking, sampling and quantisation, image processing techniques, noise reduction methods, edge detection, segmentation, vision sensors module and software structure, calibration of sensors and multisensory-controlled robot.

Module 4

Robot grippers and control system: Function and types of grippers, design aspect for gripper, force analysis for various basic gripper systems, control technologies in automation, characteristics of control systems, types of controllers, introduction to open and closed loop control, robot and industrial control systems, process industries verses discrete-manufacturing industries, continuous verses discrete control, computer process and its forms, control system components.

Module 5

Mobile robots and quadrotors UAV: Introduction of autonomous mobile robotsand quadrotors unmanned aerial vehicles (QUAV), holonomic, non-holonomic, types of locomotion, sensing, control, navigation and path planning algorithms, stability and controllability of intelligent automated vehicles (IUAV) and QUAV, driver assistance systems, driver monitoring systems, road scene interpretation, need and necessity of IAV and QUAV, industrial and non-industrial applications of IAV and QUAV.

Text Books & References:

1. Fu K.S., Gonzalez R.C. and Lee C.S.G. "Robotics", McGraw Hill Education India.
2. John J. Craig, "Introduction to robotics", Addison Wesley Longman.
3. Schilling Robert J., "Fundamentals of Robotics", Prentice Hall of India.
4. NagrathI. J. &Mittal R. K., "Robotics &Control" Tata McGraw Hill.
5. Murphy, "Introduction of AI robotics", MIT press.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: Understand basic terminologies and concepts associated with robotics and automation and aware of recent updates in robotics.

CO2: Recognize the application of various drives and actuators used in robotic systems.

CO3: Understand the functions of sensors and machine vision systems used in robotic systems.

CO4: Understand the functions of grippers and control systems used in robotic system and industries.

CO5: Understand the working principles of intelligent autonomous vehicle (IAV) and quad-rotors unmanned aerial vehicles (QUAV) used in industries and non-industries.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	-	-	-	-	-	-	2	3	3	2
CO2	3	1	3	3	1	-	-	-	-	-	-	3	2	3	2
CO3	3	2	2	2	1	-	-	-	-	-	-	2	3	2	1
CO4	3	2	2	3	1	-	-	-	-	-	-	2	3	2	2
CO5	3	2	2	3	1	-	-	-	-	-	-	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPATP1 IPPATP2 IPPATP3	**Elective – I** 1. **Computer Integrated Manufacturing** 2. **Rapid Prototyping and Tooling** 3. **Additive Manufacturing Technologies**	**3**	**0**	**0**	**40**	**60**	**100**	**3**

IPPATP1 COMPUTER INTEGRATED MANUFACTURING

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Emphasize the integration of manufacturing enterprise using computer-integrated

manufacturing (CIM) technologies.

2. Employ CAD/CAM interface and other CIM subsystems.
3. Develop database management, facility layout, Group technology, teamwork, and manufacturing operations.

COURSE CONTENTS

Module 1

Introduction: Evolution of CIM, scope of CIM, segments of generic CIM, automated process planning- process planning, group technology, variant and generative process planning methods, al in process planning, process planning software. CNC technology – principles of numerical control, features of CNC systems, programming techniques, capabilities of a typical NC CAM software, integration of CNC machines in CIM environment, DNC–flexible manufacturing systems-architecture, work stations.

Module 2

Manufacturing Systems: MRP II software, production control software, forecasting, master production schedule, materials requirements planning, capacity requirements planning, shop floor control, shop floor data collection techniques, inventory management, purchase orders, bill of materials, standard product routing, job costing, marketing applications.

Module 3

Robotics, automated assembly and inspection: Types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, selecting assembly machines, feeding and transfer of arts, applications of robots in manufacture and assembly, sensors. Automated quality control types of CMM, non-contact inspection methods, in process and post process metrology, flexible inspection systems. Computer Aided Inspection and on-line quality monitoring.

Module 4

Data communications and technology management: Technology issues, configuration management, database systems, management of technology, networking concepts, local area Network (LAN), SQL fundamentals, manufacturing automation protocols (MAP) and technical and office protocols (TOP) fundamentals– CIM models, economics of CIM, implementation of CIM.

Module 5

Collaborative Engineering: Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, supply chain management (SCM), Customer relations management (CRM) Virtual Reality and Factory simulation, Agile and lean manufacturing, reverse engineering, Rapid prototyping.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Develop an understanding of computer-integrated manufacturing (CIM) and its impact on

productivity, product cost, and quality.

2. Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.
3. Describe the integration of manufacturing activities into a complete system.

Text Books & References:

1. Manufacturing Engineering and Technology – Serope Kalpak Jain, and Steven R. Smith, Pearson education.
2. Automation, Production systems and Computer Integrated Manufacturing System – Mikell P. Groover, PHI Publication.
3. Computer Integrated Manufacturing Hand Book – Eric Teicholz and Joel Orr, McGraw Hill Publication.
4. Computer Integrated Manufacturing – Paul G. Ranky, CIMware Publishers.
5. CAD / CAM / CIM – Radhakrishnan, New Age International Publication.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	-	-	-	-	1	-	1
CO2	3	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO3	3	1	2	1	-	-	-	-	-	-	-	-	2	1	2
CO4	3	1	1	2	-	-	-	-	-	-	-	-	1	-	1
CO5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPATP2 RAPID PROTOTYPING AND TOOLING

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Familiarize the basic concepts of RPT
2. Recognize various process in RP
3. Analyze the principles of Rapid tooling and reverse Engineering.

COURSE CONTENTS

Module 1

Introduction to prototyping: Traditional prototyping vs. rapid prototyping (RP), need for time compression in product development, usage of RP parts, generic RP process, distinction between RP and CNC, other related technologies, classification of RP.

Module 2

Liquid-based rapid prototyping systems: Stereo lithography apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering

technology, laser and laser scanning, applications, advantages and disadvantages, case studies. solid ground curing (sgc): models and specifications, process, working principle, applications, advantages and disadvantages, case studies solid-based rapid prototyping systems: laminated object manufacturing (LOM): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. fused deposition modeling (FDM): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Module 3

Powder based rapid prototyping systems: Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Rapid tooling: Introduction to rapid tooling (RT), conventional tooling vs. RT, need for RT. Rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, ceramic tools, investment casting, spin casting, die casting, sand casting, 3D keltool process. Direct rapid tooling: Direct AIM, LOM tools, DTM rapid tool process, EOS direct tool process and direct metal tooling using 3DP.

Module 4

Rapid prototyping data formats: STL format, STL file problems, consequence of building valid and invalid tessellated models, STL file repairs: generic solution, other translators, newly proposed formats. rapid prototyping software's: features of various RP software's like magic's, mimics, solid view, view expert, 3 D view, velocity 2 , rhino, STL view 3 data expert and 3 D doctor.

Module 5

RP applications: Material relationship, application in design , application in engineering, analysis and planning, aerospace industry, automotive industry, jewellery industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bio-molecules.

COURSE OUTCOMES:

At the end of the course students will be able to

1. Use different techniques for processing of CAD models for rapid prototyping.
2. Apply fundamentals of rapid prototyping techniques.
3. Use appropriate tooling for rapid prototyping process.
4. Develop different rapid prototyping techniques for reverse engineering.

Text Books & References:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping

to Direct Digital Manufacturing, Springer.

3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Hilton P, Jacobs P F, Rapid Tooling: Technologies and Industrial Applications, CRC press.
5. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
6. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	1	-	-	-	-	-	-	-	1	-	1
CO2	3	1	1	2	1	-	-	-	-	1	-	-	2	2	-
CO3	3	2	3	3	2	-	-	-	-	-	-	-	2	1	2
CO4	3	3	1	1	1	-	-	-	-	-	-	-	1	1	1
CO5	3	1	1	2	1	-	-	-	1	-	3	-	2	2	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPATP3 SUPPLY CHAIN MANAGEMENT

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1 To define supply chain, its importance and management.
2. To categorize various drivers of supply chain for grasping effectual performance
3. To understand about uncertainty, risk management and forecasting.
4. To outline competitive advantages, distribution networks and supply chain strategies
5. To elaborate drivers and barriers of distribution networks in practice.

COURSE CONTENTS

Module 1

Building a strategic framework to analyze supply chains: Supply chain and its objective, the importance of supply chain decisions, decision phases in a supply chain, process view of a supply chain, examples of supply chains, supply chain performance: achieving strategic fit and scope, competitive and supply chain strategies, achieving strategic fit, expanding strategic scope, supply chain drivers and metrics, drivers of supply chain performance, framework for structuring drivers, facilities, inventory, transportation, information, sourcing, pricing.

Module 2

Designing the supply chain network: Designing distribution networks and applications to e-business the role of distribution in the supply chain, factors influencing distribution network design, design options for a distribution network, e-business and the distribution network, distribution networks in practice.

Network design in the supply chain: The role of network design in the supply chain, factors

influencing network design decisions framework for network design decisions, models for facility location and capacity allocation, role of IT in network design, making network design decisions in practice.

Network design in an uncertain environment: Impact of uncertainty on network design, discounted cash flow analysis, representations of uncertainty, evaluating network design decisions using decision trees, AM tires: evaluation of supply, chain design decisions under uncertainty, risk management and network design, making supply chain decisions under uncertainty in practice.

Module 3

Planning demand and supply in a supply chain: Demand forecasting in a supply chain**,** the role of forecasting in a supply chain, characteristics of forecasts, components of a forecast and forecasting methods, basic approach to demand forecasting, time-series forecasting methods, measures of forecast error, forecasting demand at Tahoe salt, role of IT in forecasting, risk management in forecasting, forecasting in practice.

Aggregate planning in a supply chain: Role of aggregate planning in a supply chain, the aggregate planning problem, aggregate planning strategies, aggregate planning using linear programming, aggregate planning in excel. Role of IT in aggregate planning, implementing aggregate planning in practice.

Planning supply and demand in a supply chain: Managing predictable variability**,** responding to predictable variability in a supply chain, managing supply, managing demand, implementing solutions to predictable variability in practice.

Module 4

Planning and managing inventories in a supply chain: Managing economies of scale in a supply chain, cycle inventory, the role of cycle inventory in a supply chain, economies of scale to exploit fixed costs, economies of scale to exploit quantity discounts, short-term discounting: trade promotions, managing multiechelon cycle inventory, estimating cycle inventory-related costs in practice.

Managing uncertainty in a supply chain: Safety inventory**,** the role of safety inventory in a supply chain, determining appropriate level of safety inventory, impact of supply uncertainty on safety inventory, impact of aggregation on safety inventory, impact of replenishment policies on safety inventory, managing safety, inventory in a multiechelon supply chain, role of IT in inventory management, estimating and managing safety inventory in practice.

Determining the optimal level of product availability: Importance of the level of product availability, factors affecting optimal level of product availability, managerial levers to improve supply chain profitability, setting product availability for multiple products under capacity constraints, setting optimal levels of product availability in practice.

Module 5

Designing and planning transportation networks: Transportation in a supply chain**,** the

role of transportation in a supply chain, modes of transportation and their performance characteristics, transportation infrastructure and policies, design options for a transportation network trade-offs in transportation design, tailored transportation, role of IT in transportation risk management in transportation, making transportation decisions in practice.

Managing cross-functional drivers in a supply chain: Sourcing decisions in a supply chain, the role of sourcing in a supply chain, in-house or outsource, third- and fourth-party logistics providers, supplier scoring and assessment, supplier selection-auctions and

negotiations contracts and supply chain performance, design collaboration, procurement process, sourcing planning and analysis, role of IT in sourcing, risk management in sourcing, making sourcing decisions in practice.

COURSE OUTCOMES:

After the completion of this course, students will be:

1. Demonstrate a basic understanding about competition and supply chain strategies.
2. Acquire knowledge about distribution network, E-business and time-series.
3. Demonstrate technical understanding about demand, inventory, safety, pricing.
4. Implement decision making policies, infrastructure and optimum design for handling transportation network.
5. Resolve uncertain and risk decision in decision making and can capably tailored transportation and supply chain costs.

Text Books & References:

1. Supply Chain Management: Janat Shah, Pearson Publications 2010.
2. Supply Chain Management: Sunil Chopra and Mein del, Fourth Edition, PHI 2010.
3. Supply Chain Management: A.S.Altekar PHI Second Ed.2006.
4. Logistics Management: James Stock and Douglas Lambert. McGraw Hill International Ed.2006.
5. Supply Chain Management for Global Competitiveness :Ed.B.S.Sahay McMillan Publication 2000
6. Emerging Trends in Supply Chain Management: Ed.B.S.Sahay McMillan Publication 2000.
7. Logistics Management: Bowersox TMH 2004.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3
CO1	3	2	3	2	2	-	2	-	2	-	2	2	3	2	3
CO2	3	3	3	2	2	3	2	2	2	-	2	-	3	2	2
CO3	3	3	2	2	2	2	-	-	2	-	2	2	2	3	-
CO4	3	3	2	2	-	2	2	-	2	-	2	2	3	2	-
CO5	3	3	-	3	-	1	-	1	2	-	2	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPATP4 IPPATP5 IPPATP6	**Elective – II** 1. **Advanced Manufacturing Processes** 2. **Mechanics of Sheet Metal Forming** 3. **Micro-manufacturing**	3	0	0	40	60	100	3

IPPATP4 Advanced Manufacturing Processes

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Provide the in depth knowledge of the types of advanced manufacturing and machining processes (AMPs); evolution, and need.
2. Acquire fundamental knowledge and understanding of Production and Industrial Engineering and to know about the applications of advanced manufacturing processes
3. Make acquainted the various unconventional manufacturing processes
4. Create a congenial environment that promotes learning, growth and imparts ability to work with multi-disciplinary groups in professional, industry and research organizations
5. Encourage the students for developing the models of Advanced Manufacturing Processes

COURSE CONTENTS

Module 1

Advanced foundry processes - metal mould, continuous, squeeze, vacuum mould, evaporative pattern, and ceramic shell casting.

Module 2

Non-traditional machining: Introduction, need, AJM, parametric analysis, process capabilities, USM –mechanics of cutting, models, parametric analysis, WJM: principle, equipment, process characteristics, performance, EDM: principle, equipment, generators, analysis of R-C circuits, MRR, surface finish, WEDM.

Module 3

Laser beam machining: Principle of working, equipment, material removal rate, process parameters, performance characterization, applications. Electron beam machining: principle of working, equipment, material removal rate, process parameters, performance characterization, applications. Electro chemical machining: principle of working, equipment, material removal rate, process parameters, performance characterization, applications.

Module 4

Advanced forming processes: Electro-magnetic forming, explosive forming, electro-hydraulic forming, stretch forming, contour roll forming.

Module 5

Advanced welding processes - EBW, LBW, USW.

COURSE OUTCOMES:

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

1. Categorize different material removal, joining processes as per the requirements of material being used to manufacture end product.
2. Select material processing technique with the aim of cost reduction, reducing material wastage & machining time.
3. Identify the correct advanced manufacturing processes by formulating and determining the correct AMPs for development of various complex shaped geometries.
4. Interpret foundry practices like pattern making, mold making, core making and inspection of defects.
5. Classify different plastic molding processes, extrusion of plastic and thermoforming and select appropriate joining processes to manufacture any component.

Text Books and References:

1. Manufacturing Engineering and Technology by Kalpak Jain, Addison Wesley, 1995.
2. Materials and Processes in Manufacturing (8th Edition), E.P. De Garmo, J. T Black, R.A. Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-978760).
3. Advanced Machining Processes by V. K. Jain, Allied Publications.
4. Manufacturing Science, A. Ghosh, and A.K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi
5. Nontraditional Manufacturing Processes, G.F. Benedict, Marcel Dekker, Inc. New York (ISBN 0-8247-7352-7).
6. Introduction to Manufacturing Processes by John A Schey, Mc Graw Hill.
7. Non-Traditional Manufacturing Processes by Gary F Benedict, CRC Press.
8. Advanced Methods of Machining by J. A Mc Geough, Springer

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2					-	1	1	1	1	2	2
CO2	2	2	2	1					1	1	1	2	1	2	2
CO3	1	2	2	2					2	1	1	1	2	2	2
CO4	2	1	2	2					-	1	1	2	2	2	2
CO5	2	1	1	2					-	1	1	1	2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPATP5 MECHANICS OF SHEET METAL FORMING

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Develop various metal forming processes
2. Generate the concept of plastic deformation during forming processes
3. Different laws and equations developed for solving metal forming problems

COURSE CONTENTS

Module 1

Classification of forming processes mechanism of metal forming, temperature of metal working, hot working, cold working, friction and lubricants. Rolling of metals: rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations.

Module 2

Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. Extrusion: classification, hot extrusion, analysis of extrusion process, defects in extrusion, extrusion of tubes, and production of seamless pipes.

Module 3

Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing. Sheet metal forming: forming methods, bending, stretch forming, spinning and advanced techniques of sheet metal forming, forming limit criteria, defect in formed parts.

Module 4

HERF, electromagnetic forming, residual stresses, in-process heat treatment, computer applications in metal forming. Press tool design: design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

Module 5

Forming methods dies & punches, progressive die, compound die, combination die, rubber forming, open back inclinable press (OBI press), piercing, blanking, bending, deep drawing, LDR in drawing, forming limit criterion, defects of drawn products, stretch forming. Roll bending & contouring, simple problems

COURSE OUTCOMES:

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

1. Generate the concept of different metal forming process.
2. Approach metal forming processes both analytically and numerically
3. Design metal forming processes
4. Develop approaches and solutions to analyze metal forming processes and the associated problems and flaws.

Text Books and References:

1. Mechanical Metallurgy / G.E. Dieter / Tata McGraw Hill, 1998. III Edition.

2. Principles of Metal Working / Sunder Kumar.
3. Principles of Metal Working processes / G.W. Rowe.
4. ASM Metal Forming Hand book.
5. Mechanical metallurgy (SI Units), G.E.Dieter, McGraw hill Pub-2001.
6. Manufacturing Science, Amithab Gosh & A.K.Malik, East-West press 2001.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2					-	1	1	2	1	2	2
CO2	2	2	2	1					1	1	1	2	1	2	2
CO3	1	2	2	2					2	1	1	2	2	2	2
CO4	2	1	1	2					-	1	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPATP6 MICRO-MANUFACTURING

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. To introduce the principles fundamental and process mechanics of micromachining
2. To understand of mechanics at micro level machining.
3. To analyze on the mechanical/chemical behavior changes during micromachining/manufacturing.
4. To evaluate micro and macro machining, visualize micro machining process.
5. To understand application and advancements in the micro machining process.

COURSE CONTENTS

Module 1

Introduction and classification of micromachining, Mechanical type micro machining processes: Abrasive jet micromachining (AJMM), Ultrasonic micromachining, abrasive water jet micro machining (AWJMM).

Module 2

Magnetorheological finishing (MRF), Magnetorheological abrasive flow finishing (MRAFF), Magnetic float polishing (MFP).

Module 3

Chemical and electrochemical type advanced machining processes, Electrochemical micromachining (EDMM), electrochemical micro deburring, chemical and photochemical micromachining. Abrasive based nano finishing processes, abrasive flow finishing (AFF), chemo-mechanical polishing (CMP), magnetic abrasive finishing (MAF)

Module 4

Thermo electric type micro-machining process, electric discharge micromachining (EDMM), wire

EDM, EDDG, ELID, laser beam micro machining (LBMM), electron beam micromachining (EBMM)

Module 5

Traditional mechanical micro-machining processes, micro turning, micro milling, micro drilling.

COURSE OUTCOMES:

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

1. Acquire knowledge about different micro-machining processes.
2. Acquire knowledge about super finishing processes.
3. Understand about the capabilities of different micro-manufacturing processes.
4. Understand about the capabilities of different advanced micro-manufacturing processes.
5. Understand about the capabilities of traditional micro-manufacturing processes.

Text Books & References

1. Introduction to micromachining, VK Jain, Narosa Publisher, New Delhi 2nd edition.
2. Micromachining methods, JA Mc Geough, Champan and Hall, London.
3. Micro manufacturing processes, VK Jain CRC Press.
4. Advanced machining processes, VK Jain, Allied Publisher New Delhi.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2					-	1	1	2	1	2	2
CO2	2	2	2	1					1	1	1	2	1	2	2
CO3	1	2	1	2					2	1	1	2	2	2	2
CO4	2	2	2	2					-	1	1	2	2	2	2
CO5	2	2	2	2					-	2	1	2	1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPATP7 **IPPATP8** **IPPATP9**	**Elective – III** 1. **Modeling & Simulation** 2. **Theory of Vibration** 3. **Artificial Intelligence**	**3**	**0**	**0**	**40**	**60**	**100**	**3**

IPPATP7 MODELING & SIMULATION

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Design the importance of modeling to science and engineering.
2. Describe future trends and issues in science and engineering, and identify specific industry related examples of modeling in science and engineering.
3. Utilize the modeling Process to identify the key parameters of a model, estimate model outcomes, utilize a computational tool, e.g. MATLAB to implement the mathematical representation of the model, convey the results of the simulation accurately, validate the model with data, and discuss the quality and sources of errors in the model.
4. Conduct the transforming of continuous functions and dynamics equations into discrete computer representations.
5. Examine mathematical representations of functions - Describe and utilize linear and nonlinear functions to model empirical data. Visualize empirical data and the fitting function using a computational tool.

COURSE CONTENTS

Module 1

Introduction: Definition and components of a system, continuous and discrete systems. Modelling: concepts of system modeling, types of models, static and dynamic physical models, static and dynamic mathematical models. Simulation: basics of simulation, steps in simulation, discrete event system simulation, advantages and disadvantages of simulation, decision making with simulation.

Module 2

Statistical Models: Review of terminology and concepts, useful statistical models, discrete distributions, continuous distributions, poisson process, empirical distributions, random numbers, techniques for random generation. Queuing models: characteristics of queuing systems; queuing notation; long-run measures of performance of queuing systems, application of models.

Module 3

System simulation: Techniques of simulation, Monte Carlo method, experimental nature of simulation, distributed lag models, Cobweb models continuous system models, analog and hybrid simulation, feedback systems, computers in simulation studies.

Module 4:

Simulation software: Comparison of simulation packages with programming languages, classification of simulation software, description of a general purpose simulation package, design of scenario and modules, dialog box, database, animation, plots and output, interfacing with other software, summary of results, examples with MATLAB/ AWESIM / ARENA.

Module 5

Analysis after simulation: Importance of the variance of the sample mean, procedure for estimating mean and variance, subinterval method, replication method, regenerative method; variance reduction techniques, start up policies, stopping rules, statistical inferences, design of experiments. verification

and validation of simulated models, optimization via simulation. Case studies on application of modeling and simulation in manufacturing systems.

COURSE OUTCOMES:

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

1. Develop the techniques of modeling in the context of hierarchy of knowledge about a system and develop the capability to apply the same to study systems through available software.
2. Analyze different types of simulation techniques.
3. Simulate the models for the purpose of optimum control by using software.
4. Identify different types of models and simulations, describe the iterative development process of a model, and
5. Explain the use of models and simulations for hypothesis testing and explain how models link the physical world, the virtual world and the science of prediction.

Text books & References:

1. Averill M. Shaw, "Simulation Modeling and Analysis", Tata McGraw-Hill, 2007.
2. Frank L. Severance, "System Modeling & Simulation-an Introduction", JohnWiley & Sons, 2001.
3. Geoffrey Gordon, "System Simulation", Prentice Hall India, 1969.
4. Robert E. Shannon, "System Simulation: The Art and Science", Prentice Hall India, 1975.
5. Charles M Close and Dean K. Frederick Houghton Mifflin, "Modelling and Analysis of Dynamic Systems: TMH, 1993.
6. Allan Carrie, "Simulation of manufacturing", John Wiley & Sons, 1988

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	2					-	1	1	2	1	2	2
CO2	2	2	2	1					1	1	1	2	1	2	2
CO3	1	2	1	2					2	1	1	2	2	2	2
CO4	2	2	2	2					-	1	1	2	2	2	2
CO5	2	2	2	2					-	2	1	2	1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPATP8 THEORY OF VIBRATION

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Formulate mathematical models of problems in vibrations using Newton's second law or energy principles,

2. Determine a complete solution to the modeled mechanical vibration problems.
3. Correlate results from the mathematical model to physical characteristics of the actual system.
4. To be able to mathematically model real-world mechanical vibration problems

COURSE CONTENTS

Module 1

Element of vibration system: Lumped mass, stiffness and damping, simple harmonic motion, vector representation. Single degree of freedom system, equation of motion-energy method, Newton law based, general solution, free and forced vibration, damped and undamped motion.

Module 2

Damed vibration, equivalent damping, logarithmic decrement, damping measurement, forced vibration, rotating and reciprocating unbalance, vibration, absorber, seismic instruments.

Module 3

Transient vibration: Impulse response, convolution integral, Fourier analysis.

Module 4

Multi degree freedom system, equation of motion, co-ordinate coupling, undamped forced vibration, principal modes, generalized co-ordinates, semi-definite system, orthogonalty of modes, modal analysis, Lagrange's equation.

Natural frequency numerical solution: Rayleigh's method, Dunkerley's method, Holzer method, Transfer matrix, Iteration method.

Module 5

Continuous system: Vibration of stretched cord, torsional vibration, longitudinal, vibration of slender rod, lateral vibration of beams, shear deformation and rotary inertia effect, Rayleigh's quotient, Rayleigh' s-Ritz method.

COURSE OUTCOMES:

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

1. Determine the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.
2. Analyze the mathematical modelling of the two degrees of freedom systems and explain about the working principle of vibration absorber.
3. Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system.
4. Select the numerical methods to determine natural frequencies of the beam and rotor systems.
5. Describe the vibration measurement by using transducers and vibration exciters.

Text Books & References:

1. Tse. S, Morse R Rolland T. Hinkle. Ivan E. "Mechanical vibrations theory and Application" Published by Allyn and Bacon.
2. Thomson T. Milliam "Theory of vibrations with applications" Prentice Hall of India.

3. Hartog Den, J.P. "Mechanical vibrations "Tata McGraw Hills,4th edition 1956)
4. MeirovitchL."elementsofvibarationanalysisMcGrawHills-1956
5. Anderson R. A. "Fundamentals of vibration "Mecmillan press1967
6. Kbstad N.O. 'Fundamentals of vibration analysis "McGraw Hills-1956
7. Robert K.Vicrck "Vibration analysis "Published by Harper & Row
8. Timoshenko S., Young D.H. & Ileavev W.Jr. "Vibration problem in engineering 4th ed, New York Willey 1974
9. Merovitch, L.,*Analytical methods in vibration" published by Macmillan (1967).

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	2	3	1	3
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3
CO3	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO4	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPATP9 ARTIFICIAL INTELLIGENCE

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To impart knowledge about Artificial Intelligence.
2. To give understanding of the main abstractions and reasoning for intelligent systems.
3. To enable the students to understand the basic principles of Artificial intelligence in various applications.

COURSE CONTENTS

Module 1

Introduction to artificial intelligence and intelligent agents, categorization of AI, production systems and rules for some AI problems: water jug problem, missionaries-cannibals problem etc. Solving problems by searching: state space formulation, depth first and breadth first search, iterative deepening.

Module 2

Intelligent search methods, memory restricted variants Heuristic search: Hill climbing, best-first search, problem reduction, constraint satisfaction. Game playing: minimax, alpha-beta pruning.

Module 3

Knowledge and reasoning: Propositional and first order logic, semantic networks, building a knowledge base, inference in first order logic, logical reasoning systems

Planning: Components of a planning system, goal stack planning, non-linear planning strategies, probabilistic reasoning systems, Baysian networks.

Module 4

Learning: Overview of different forms of learning, inductive learning, learning decision trees, computational learning theory, artificial neural networks (ANN).

Evolutionary computation: Genetic algorithms, swarm intelligence, particle swarm optimization.

Module 5

Applications: Robotics, natural language processing etc.

COURSE OUTCOMES:

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

1. Solve basic AI based problems.
2. Define the concept of artificial intelligence.
3. Apply AI techniques to real-world problems to develop intelligent systems.
4. Select appropriately from a range of techniques when implementing intelligent systems.

Text & Reference Books

1. Rich and Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2014.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, 2011.
3. Deepak Khemani, "A First Course in Artificial Intelligence", Tata McGraw Hill, 2013.
4. S. Russel and P.Norvig,"AI: A modern approach", 3rd Edition, Pearson Education, 2009.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	-				-	1	1	2	1	2	2
CO2	2	2	2	1	1				1	1	1	2	1	2	2
CO3	1	2	2	2	1				2	1	1	2	2	2	2
CO4	2	2	2	2	1				-	1	1	2	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPATC1	**Research Methodology & IPR**	**2**	**0**	**0**	**-**	**50**	**50**	**2**

IPPATC1 RESEARCH METHODOLOGY & IPR

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.
5. Right to be promoted among students in general & engineering in particular.

COURSE CONTENTS

Module 1

Introduction and design of research: Meaning, objectives and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative vs. quantitative research methodology, field studies, field experiments vs. laboratory experiments, research design in social and physical sciences.

Module 2

Data and methods of data collection: Survey, assessment and analysis: data collection, primary and secondary sources of data, collection of primary data through questionnaire and schedules. Collection of secondary data, processing and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multistage sampling. Pilot survey, scaling techniques, validity & reliability.

Module 3

Data nalysis: Procedure for testing of hypothesis, the null hypothesis, determining levels of significance, type i and ii errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance: one way, two way, chi square test and its application, students ‘T’ distribution, non-parametric statistical techniques, binomial test. Correlation and regression analysis – discriminate analysis – factor analysis – cluster analysis, measures of relationship

Module 4

Research report preparation and presentation: Review of literature: historical survey and its necessity, layout of research plan, meaning, techniques and precautions of interpretation, types of report: technical report, popular report, report writing – layout of research report, mechanics of writing a research report. Writing bibliography and references.

Module 5

Nature of Intellectual Property: Patents, designs, trade and copyright. Process of patenting and development: technological research, innovation, patenting, development. Iternational scenario: international cooperation on intellectual property. Procedure for grants of patents, patenting under PCT

COURSE OUTCOMES:

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

1. Student will be able to understand research problem and its formulation.
2. They will be able to analyze research related information.
3. Students will understand the research ethics. Students will able to understand the basics of IPR.

Text Books and References:

1. Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon.
2. Research Methodology – Methods and Techniques, C K Kothari, New Age International.
3. Design and Analysis of Experiments, D C Montgomery, Wiley.
4. Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley.
5. Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs 1	PSOs 2	PSOs 3
CO1	-	2	3	2	1	2	3	1	1	2	2	1	3	2	2
CO2	-	3	3	3	1	3	3	1	2	2	2	2	1	2	2
CO3	-	2	1	2	2	2	3	2	1	2	3	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPALT1	**CAD-CAM lab**	**0**	**0**	**4**	**30**	**20**	**50**	**2**

IPPALT1 CAD-CAM LAB

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. Interpret drawings of machine components.
2. Prepare assembly drawings both manually and using standard CAD packages.
3. Familiarize the students with Indian Standards on drawing practices and standard components.
4. Gain practical experience in handling 2D drafting and 3D modeling software systems.
5. Analyze the features of CNC Machine Tool.
6. Expose students to modern control systems (Fanuc, Siemens etc.,).
7. Give exposure to software tools needed to analyze engineering problems.
8. Give exposure of different applications of simulation and analysis tools.

LIST OF EXPERIMENTS

1. 2D Drafting of Plummer block bearing.
2. 2D Drafting of Non-return valves.
3. 2D Drafting of Safety valve.
4. 3D Assembly of Flange coupling.
5. 3D Assembly of Universal coupling.
6. 3D Assembly of Oldham's coupling.
7. 3D Assembly of Knuckle joint.
8. 3D Assembly of Socket and Spigot joint.
9. 3D Assembly of Gib and Cotter joint.
10. 3D Assembly of Connecting rod.
11. 3D Assembly of Piston.
12. 3D Assembly of Stuffing box.
13. 3D Assembly of Screw jack.
14. 3D Assembly of Machine vice.
15. Create the Modeling of simple machine component -I.
16. Create the Modeling of simple machine component -II.
17. Create Screw Jack assembled model.
18. Create Knuckle Joint assembled model.
19. Create universal coupling assembled model.
20. Create Plummer block assembled model.
21. Create Flange coupling assembled model.
22. Generate the CNC programming for turning and taper turning operation using canned cycle
23. Generate the CNC programming for Thread cutting operation using canned cycle
24. Generate the CNC programming for Milling operation using canned cycle
25. Generate the CNC programming for Drilling operation using canned cycle
26. Generate the CL Data and Post process generation using CAM package.

COURSE OUTCOMES:

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

1. Execute steps required for modeling 3D objects by using protrusion, cut, sweep, extrude

commands.

2. Convert 3D solid models into 2D drawing-different views, sections.
3. Use isometric views and dimensioning of part models.
4. Machine simple components on CNC machines.
5. Use CAM software to generate NC code.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2					-	1	1	1	1	2	2
CO2	3	2	2	1					1	1	1	2	1	2	2
CO3	1	2	2	2					2	1	1	1	2	2	2
CO4	2	1	2	2					-	1	1	2	2	2	2
CO5	2	2	1	2					-	1	1	1	2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBTT1	Finite Element Analysis	3	0	0	40	60	100	3

IPPBTT1 FINITE ELEMENT ANALYSIS

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Implement the basics of FEM to relate stresses and strains.
2. Formulate the design and heat transfer problems with application of FEM.
3. Solve 1 D, 2 D and dynamic problems using Finite Element Analysis approach.

COURSE CONTENTS

Module 1

Historical background, Basic concept of the Finite Element Method, basic equations in elasticity, elemental shapes, nodes, nodal unknowns and coordinate systems, general procedure for finite element analysis, application to the continuum, discretization of the domain, governing equations for continuum, pre-processor, processer and post processer.

Module 2

Basic concept of interpolation functions, shape function in one, two and three dimension, finding of shape function by polynomial, Lagrange polynomial, serendipity family and Hermite polynomial, construction of shape function by degrading technique.

Module 3

Strain displacement and elemental stiffness matrix, assembling stiffness equation, boundary conditions and solution, spring and bar elements, direct approach, strain energy, Castigliano's first theorem, minimum potential energy, Galerkin's method, and variational method, isoparametric formulations.

Module 4

Finite Element Analysis: Bars, beams trusses and rigid frame, heat transfer, fluid and solid mechanics.

Module 5

Introduction to non-linear finite element methods: Adaptive finite analysis, automatic mesh generation, choice of new mesh, transfer variables.

Text & Reference Books:

1. Rao S. S., "The Finite Element Method in Engineering", Elsevier Science & Technology.
2. Hutton D. V., "Fundamental of Finite Element Analysis", McGraw Hills.

3. Cook R. D., Malkus, D.S. and Plesha, M.E., “Concepts and Applications of Finite Element Analysis", 3rd Ed., JohnWiley & Sons.
4. Bathe K. J., "Finite Element Procedures ",Prentice Hall of India, NewDelhi.
5. HuebnerK.H.andThorton,E.A.,"TheFiniteElementMethodsforEngineers”John Wiley &Sons.
6. ZienewiczO.C.andTaylor,R.L.,"TheFiniteElementMethods",Vol.1,Vol.2and Vo1.3, McGrawHill.
7. Belytshko, T., Liu, W. K. and Moran, B., Non-linear Finite Elements for Continua and Structures", McGraw Hills.

COURSE OUTCOMES:

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

CO1: Implement numerical methods to solve mechanics of solids problems.

CO2: Formulate and Solve axially loaded bar Problems.

CO3: Formulate and analyze truss and beam problems.

CO4: Implement the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements.

CO5: Formulate and solve Axi-symmetric and heat transfer problems.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	-	2	3	2	2
CO2	3	3	3	3	2	-	-	-	-	-	-	2	2	3	2
CO3	3	3	3	2	2	-	-	-	-	-	-	2	3	2	2
CO4	3	3	3	3	2	-	-	-	-	-	-	2	3	2	2
CO5	3	3	3	3	2	-	-	-	-	-	-	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBTT2	**Robotics and Control**	**3**	**0**	**0**	**40**	**60**	**100**	**3**

IPPBTT2 ROBOTICS AND CONTROL

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Study about mechanism, mechanics and mechanical behaviour of the industrial robot.
2. Introduce the basic concept of matrix and arithmetic formulations and its analysisof the industrial robot.
3. Impart knowledge of kinematic, dynamic and trajectory behaviour of the industrial robot.
4. Introduce the concept of controller design and programming of industrial robot.
5. Explore the concept of artificial intelligence and machine learning algorithms used in the robotics.

COURSE CONTENTS

Module 1

An over view of robotics, man vs machine, progressive development, specifications and classifications of industrial robot, robot joints and terminology, mobility and degree of freedom, yaw, pitch and roll motion, equivalent angle, work envelop geometries, reach and stroke repeatability, accuracy and precision, the mechanics and control of mechanical manipulator, operating environment, industrial applications.

Module 2

Direct kinematics arm equation, spatial descriptions and transformations, kinematics redundancy and calibration, description of links and joints, coordinates frames matrices and their arithmetic, frame assignment to links, fundamental of rotation and translation, homogeneous coordinate frame, composite, inverse and skew homogenous transformation, description of position and orientation, Denavit-Hartenberg (D-H) parameters, arm equations, direct kinematic problems of industrial robots, inverse kinematics, algebraic and geometrical methods, inverse kinematic of roll pitch yaw joints, inverse kinematic problems of industrial robots, multiple solutions.

Module 3

Robot dynamics: Introduction to dynamics force, inertia and energy, principle of inertia tensor, joint velocity of manipulator, kinetic and potential energy of manipulator, Langrange-Euler formulation, equation of motion, dynamics problems of industrial robots, general description of path planning and trajectory generation, description of cartesian and joint space, manipulator Jacobians and velocity of manipulator, Trajectory generation and obstacles avoidance of industrial robot.

Module 4

Robot control theory: Introduction and system modeling of manipulator control theory, open loop and close loop control, first order and second order linear system, motion control with velocity input, properties of the dynamic model, linear and nonlinear systems control schemes control techniques, performance and stability of feedback control, proportional-derivative (PD) control, proportional-derivative-integral (PID) control, introduction of nonlinear control, multivariable robot control, computed torque control, adaptive control, hybrid control, manipulator interaction with environment, system stability and optimal control, applications and examples.

Module 5

Robot programming and machine learning, generation of robot programming, languages and software packages, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, introduction to various types such as RAIL and VAL II etc, features of type and development of languages for recent robot systems, introduction to artificial intelligence, knowledge and reasoning, artificial neural network (ANN) and its applications in robotics, fuzzy logic theories and its applications in robotics. AI based techniques for navigation, bio inspired

algorithms, multiple robot coordination, design and application of intelligent controller.

Text Books and References:

1. Fu K.S., Gonzalez R.C. and Lee C.S.G. & quot; Robotics & quot;, McGraw Hill Education India.
2. John J. Craig, "Introduction to robotics", Addison Wesley Longman.
3. Schilling Robert J., "Fundamentals of Robotics", Prentice Hall of India.
4. NagrathI.J. & Mittal R.K., "Robotics &Control" Tata McGraw Hill.
5. Murphy, & quot; Introduction of AI robotics", MIT press.

COURSE OUTCOMES:

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

CO1: Understanding the concept of man and machine operation of industrial robots used in industries and real-world environment.

CO2: Analysis of kinematic and dynamic behaviour of robot.

CO3: Understanding the concept of robot control theory and its application in robot controller.

CO4: Apply the concept of artificial intelligence and machine learning in industrial robots.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	-	-	-	-	-	-	2	3	3	2
CO2	3	1	3	3	1	-	-	-	-	-	-	3	2	3	2
CO3	3	2	2	2	1	-	-	-	-	-	-	2	3	2	1
CO4	3	2	2	3	1	-	-	-	-	-	-	2	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBTP1 IPPBTP2 IPPBTP3	**Elective – IV** **1. Green Manufacturing** **2. Advance Operation Research** **3. Total Quality Management**	**3**	**0**	**0**	**40**	**60**	**100**	**3**

IPPBTP1 GREEN MANUFACTURING

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. To develop the basic concepts of the three pillars of sustainability and how they are manifested in sustainable and green manufacturing as well as to facilitate the students to presume position of scientific and/or managerial leadership in their career paths towards

green manufacturing.

2. To help students to develop the basics of the green manufacturing concepts, strategy, different technology used to implement green manufacturing.
3. To develop the basic concepts of Life Cycle Assessment approach to evaluate environmental impacts of product design, manufacturing processes, product use-phase, and product end-of-life.
4. To broaden and deepen their capabilities and understanding towards concepts of different types of green technology.
5. To help students to develop the basic understanding on lean and green technology and differences and similarities between both

COURSE CONTENTS

Module 1

Introduction: Sustainable development, indicators of sustainability, sustainability strategies, sustainable manufacturing,evolution of sustainable manufacturing, elements of sustainable manufacturing, theory of green manufacturing and its principles, need for green manufacturing, drivers and barriers of green manufacturing.

Module 2

Green manufacturing strategy: Manufacturing strategy, elements of manufacturing strategy, manufacturing outputs, competitive priorities: quality, delivery speed and reliability, cost efficiency, flexibility, order winners and order qualifier, tradeoff, production systems, manufacturing levers, competitive analysis, level of manufacturing capability, framework for formulating manufacturing strategy, implications of green manufacturing for manufacturing strategy.

Module 3

Life cycle approach of green manufacturing: Holistic and total Life-cycle approach, six step methodologies for green manufacturing (6-R approach), life cycle assessment (LCA), elements of LCA – life cycle costing, eco labeling target setting, data collection and processing, final evaluation by virtue of criteria, environmental management systems.

Module 4

Green manufacturing technology: Definition of green manufacturing technology and practices, classifications of green manufacturing technology, advantages and disadvantages of implementation of green technology.

Module 5

Lean and green manufacturing: Introduction, lean evolution &steps, introduction to lean manufacturing, definition of lean manufacturing, lean vs. green manufacturing: similarities and differences.

COURSE OUTCOMES:

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

CO1- Graduate will demonstrate the ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

CO2- Graduate will become familiar with green manufacturing concepts and practices and analyze the problems within the domains of Green Manufacturing as the members of multidisciplinary teams. As well will be able to formulate appropriate green manufacturing strategy.

CO3-Graduate will be trained towards the basic concepts of Life Cycle Assessment approach to evaluate environmental impacts of product design, manufacturing processes, product use-phase, and product end-of-life.

CO4- Formulate and apply different green technologies as per the requirement and situations and able to plan good housekeeping practices for Industry/other places with concern of safety, hygiene and waste reduction.

CO5- Apply different approaches of lean and green manufacturing in the real world problem to overcome the problems arises due to manufacturing.

Text Books & References:

1. Cleaner Production: Environmental and Economic Perspectives, Misra Krishna B., Springer, Berlin, Latest edition.
2. Environmental Management Systems and Cleaner Production, Dr. Ruth Hillary, Wiley, New York, Latest edition.
3. Pollution Prevention: Fundamentals and Practice, Paul L Bishop, TMH.
4. Costing the earth, Cairncrss and Francis, Harvard Business School Press – 2009.
5. The principle of sustainability, Simon Dresner, –Earth Scan publishers (2008).
6. Manufacturing strategy: How to formulate and implement a winning plan, Jhon Miltenburg, Productivity Press Portland, Oregon-2017.
7. Manufacturing strategy, Voss C. A, Chapman & Hall-1992
8. Manufacturing the future, Steve Brown, Prentice Hall, 2000
9. Manufacturing strategy, Terry Hill, Homewood, IL- 1989
10. Becoming Lean - Inside Stories of U.S. Manufacturers, Jeffrey K. Liker, Productivity Press, Portland, Oregon
11. Handbook of Sustainable Manufacturing, G. Atkinson, S. Dietz, E. Neumayer, Edward Elgar Publishing Limited, 2007.
12. Industrial Development for the 21st Century: Sustainable Development Perspectives, D. Rodick, UN New York, 2007.
13. An Introduction to Sustainable Development, P.P. Rogers, , K.F. Jalal & J.A. Boyd, J.A, Earth scan, London, 2007.
14. Sustainable Development Indicators in Ecological Economics, P. Lawn, Edward Elgar Publishing Limited.
15. The Economics of Sustainable Development, S. Asefa, W.E. Upjohn Institute for Employment Research, 2005.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3

CO1	-	2	3	2	1	2	3	1	1	2	2	1	3	2	2
CO2	-	2	3	2	1	3	3	1	1	2	3	2	3	2	2
CO3	-	2	3	2	1	2	3	2	1	3	3	2	3	3	3
CO4	-	2	3	2	2	3	3	1	1	3	2	2	3	2	2
CO5	-	2	3	2	1	3	3	1	1	2	2	1	3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTP2 ADVANCE OPERATION RESEARCH

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. To explain the ideas about board education in the techniques and modelling concepts used to analyze and design complex systems.
2. To compile the basic concepts of LPP and various solving techniques.
3. To make use of assignment, transportation, inventory and various other techniques.
4. To illustrate the connection between basics as well the advance tools of the subject to demonstrate the link between theory and its real world.
5. To define of single and multi variable optimization methods with and without constraints

COURSE CONTENTS

Module 1

Introduction, Mathematical formulation of the problem, Graphical Solution methods, Mathematical solution of linear programming problem, Slack and Surplus variables. Matrix formulation of general linear programming Problem,

Module 2

The Simplex Method: Artificial variables, two phases Simplex Method, infeasible and unbounded LPP's, alternate optima, Dual problem and duality theorems, dual simplex method and its application in post optimality analysis, Revised Simplex method.

Module 3

Construction and solution of these Models, Hungarian method of solving assignment problem, unbalanced assignment problem, matrix form of transportation problem, Initial basic feasible solution, Balanced and unbalanced transportation problems, u-v method for solving transportation problems Selecting the entering variables, Selecting the leaving variables, Degeneracy in transportation problem.

Module 4

Introduction and characteristics of dynamic programming**,** methods of solution to DP.

Queuing models, elementary queuing models, steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

Module 5

Classical optimization techniques, introduction, review of single and multivariable optimization methods with and without constraints.

COURSE OUTCOMES:

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

1. Recall and comprehend the LPP and its formulation with solving techniques.
2. Remember, understand and analyze the analytical solution of Simplex method, Assignment problem, Transportation problem and related topics questions with effective manner.
3. Understanding to apply basics as well the advance tools of the subject to demonstrate the link between theory and its real world applications.
4. Explain the overview of historical development and review of optimization techniques.

Text Books & References:

1. Operation Research, Theory and Application by J.K. Sharma, Macmillan India
2. Quantitative techniques in Management by N. D. Vohra, TMH
3. Operations Research by P.K. Gupta and D.S. Hira, S Chand and Sons
4. Operation Research: An Introduction by H.A. Taha
5. S. S. Rao, Optimization Techniques, Wiely Eastern
6. Operations Research, Kanti Swarup, S Chand.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	-	-	-	2	-	3	3	3	3
CO2	2	-	2	2	2	2	-	-	-	1	-	2	3	2	3
CO3	3	1	2	2	3	3	-	-	-	2	-	3	3	2	2
CO4	3	3	2	2	2	2	-	-	-	1	-	2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTP3 TOTAL QUALITY MANAGEMENT

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. Recognize the basic knowledge of history and evolution of quality control and management.
2. Illustrate the philosophy and core values of quality management (QM).
3. Develop the concepts and statistical methods employed for assurance of quality in products, processes and systems in an industrial environment.
4. Determine the effect of process capability analysis and introduction of sampling plans.
5. Apply and analyze the concept of reliability and taguchi philosophy for quality.

COURSE CONTENTS

Module 1

Introduction to quality control: Definitions, place of quality control in industries, quality control organization. Difference between inspection and quality control. Economics of quality systems.

quality assurance and its manual.

Module 2

Statistical process control: Sample size and frequency of sampling and control, Design and application of control charts for variable and attribute (X.R.C, NP, P, U chart). Process capability studies.

Module 3

Acceptance sampling: AQL, LQL, producer's risk, consumer's risk, performance measures of sampling plans: OC curve and ASN curve single sampling plans. Double sampling and sequential sampling plans. Rectifying inspection for lots. Sampling plans for continuous production. Selection of sampling plans for different situations. Economics of acceptance sampling.

Module 4

Total quality management: Evolution of total quality management, historical perspective, elements of TQM: elimination of waste and problem exposure. Total quality control systems. Demings wheel, Deming 14 points-pros and cons in industrial engineering context, Philip Crosby philosophy, Juran philosophy, Ishikawa diagram. Quality function development, quality circles & ISO 9000. Application of TQM to service type organizations, various quality awards.

Module 5

Reliability: Distributions encountered in controlling reliability mean time to failure, exponential failure density, MTTF, Weibull, failure density, measurement and tests, maintenance and reliability,. robust design and Taguchi method Taguchi philosophy for quality improvement, quality loss function, signal-to-noise ratio.

COURSE OUTCOMES:

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

1. Develop conceptual understanding of quality, quality cost and value.
2. Analyze and develop control charts for statistical quality control.
3. To apply the knowledge of quality control and its tools for process capability.
4. Analyze and develop sampling plans for acceptance sampling.
5. Identify the concept of TQM and philosophy of quality leaders.
6. Identify failure pattern of product, Reliability and Maintenance.
7. Evaluate Reliability and MTTF and Examine Taguchi Philosophy for Quality improvement.

Text Books & References:

1. Grant E.L. and Leave Worth, Statistical Quality Control, TMH. 1996.
2. Amitava Mitra, Fundamentals of Quality Control and Improvement, Wiley, 2016.
3. Kapur K.C. and Lamberson, Reliability in Engg. Design Wiley Eastern.
4. Juran and Godfrey, Quality Handbook, TMH. 1998

5. Jain K.C. and Chitale A.K., Quality Assurance and Total Quality Management, Khanna Publisher, India, 2003.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	-	-	-	3	2	-	2	3	3	3
CO2	2	3	3	2	1		-			1		2	2	2	2
CO3	3	-	-	2	1	-	-	-	-	-	-	2	2	2	2
CO4	2	3	3	-	-	-	-	-	2	3		3	3	3	2
CO5	3	2	2	2	2	-	-	-	-	2	-	2	3	2	3
CO6	3	2	2	-	2	-	-	-	-		-	3	3	3	3
CO7	3	2	3	2	2	2	-	-	1	-	-	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBTP4 **IPPBTP5** **IPPBTP6**	**Elective – V** **4. Mechanics of Composite Material** **5. Smart Materials and Applications** **6. Mechatronics in Manufacturing Systems**	**3**	**0**	**0**	**40**	**60**	**100**	**3**

IPPBTP4 MECHANICS OF COMPOSITE MATERIAL

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand the fundamental properties of composite materials;
2. Apply the fundamental principles mechanics of composite materials;
3. Apply modern analytical techniques to mechanical systems with composite materials;
4. Apply computational techniques to mechanical systems with composite materials;
5. Understand the manufacturing processes and cost analysis in composite materials;
6. Demonstrate effective communication and teamwork skills through technical presentations and reports in term projects.

COURSE CONTENTS

Module 1

Introduction: Definition of composites; classification of composites; Fibers and matrix materials and their properties; generalized Hook's law- orthotropic, transversely isotropic and isotropic materials; constitutive equations under plane stress condition for orthotropic materials, restrictions on elastic constants of orthotropic materials.

Module 2

Macromechanics of Lamina: Stress-strain relations for a lamina of arbitrary orientation, invariant properties of an orthotropic lamina, strength of an orthotropic lamina, experimental determination of strength and stiffness, biaxial strength theories of an orthotropic lamina: maximum stress theory, maximum strain theory, Tsai-Hill theory, Tsai-Wu tensor theory.

Module 3

Micromechanics of lamina: Mechanics of materials approach to stiffness (determination of E_1, E_2, U_{12} & G_{12}); mechanics of materials approach to strength; tensile and compressive strength in fiber directions, elasticity approach to stiffness, some results of exact solution.

Module 4

Micromechanics of laminate: Classical lamination theories (CLT)- laminate stress, laminate stiffness-A-B-D matrix and their implication, symmetric and non-symmetric laminates interlaminate stress, limitations of classical lamination theory.

Module 5

Short Fiber Composites: Theories of stress-transfer, average fiber stress, modulus prediction, strength prediction, effect of matrix ductility, ribbon–reinforced composites.

COURSE OUTCOMES:

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

1. Determine composite mechanical properties from constituent fiber and matrix material properties including longitudinal and lateral moduli, Poisson's ratio, and shear modulus.
2. Determine the generalized stiffness and compliance matrix relating in-plane stresses to strains for a composite layer assuming plane stiffness.
3. Apply classical laminated plate theory to determine extensional, coupling, and bending stiffnesses of a composite laminate. Also be able to perform this calculation using MATLAB for a composite laminate with many layers.
4. Fabricate composite laminates and built-up composite structures such as I-beams, box beams, or model-scale aircraft wings using a composite manufacturing procedure.

Text & Reference books:

1. “Modern Composite Materials” by L J Broutman and R M Krock,
2. “Composite Materials – Science and Engineering” by K K Chawla,
3. “Mechanisms and Mechanics of Composite Fracture” by R B Bhagat and S G Fishman,
4. “An Introduction To Composite Materials” by D Hull, “STRUCTURAL COMPOSITE MATERIALS” by F C Campbell.
5. “Composite Materials” by Berthelot, “Electrostatic Discharge Sensitivity of Composite Energetic Materials” by Michelle L Pantoya and Chelsea Weir.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	2	1	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3
CO3	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO4	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTP5 SMART MATERIALS AND APPLICATIONS

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Describe different types of smart materials in terms of underlying mechanisms, advantages and disadvantages.
2. Select the most appropriate smart material system for a design problem under specified design constraints.
3. Possess a general picture of smart material systems and knowledge about current research areas and future trends.
4. Design of sensors and actuators using smart materials and learn about Energy harvesting using piezoelectric materials
5. Describe Magneto rheological fluid and its applications

COURSE CONTENTS

Module 1

Definition of smart materials, what makes them smart, sensors, actuators, and transducers; introduction to different types of smart material, smart materials; history and industrial application.

Module 2

Piezoelectric materials: Crystallography and crystal structure, mechanism of piezolelectricity, common piezoelectric materials, applications, derivation of constitutive laws from energy principle and its application as actuator, sensor, and energy harvester. Superelasticity, superelastic materials phase transformation.

Module 3

Shape memory alloys: Martensitic transformations, shape memory effect and super- elasticity, mechanical behaviour and shape memory characteristics of different shape memory alloy systems, Ti-Ni phase diagrams.

Module 4

Thermally and magnetically activated Shape memory alloy: constitutive modelling using phenomenological and thermodynamic approaches, its applications as actuator, sensor, energy dissipater, and stent like biomedical items, design and application of shape memory alloys.

Module 5

Magneto rheological fluid: constitutive behaviour and its applications as damper, behaviour of electro active polymer and its use as artificial muscles; properties of magnetostrictive materials and optical fibre.

COURSE OUTCOMES:

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

1. Design and construct simple functional structures using smart materials.
2. Describe and characterize mechanical behavior of smart materials.
3. Characterize interaction between smart materials and simple structures in actuation and sensing.
4. Describe and characterize novel functions of smart materials using structure-property relationships.
5. Present and demonstrate the functions of smart structures.

Text & Reference Books:

1. Mel M. Schwartz, Smart Materials, CRC Press, 2009.
2. Donald J. Leo, Engineering analysis of smart material systems, John Wiley & Sons, 2007.
3. Jiashi Yang, Analysis of piezoelectric devices, World Scientific, 2006.
4. Ralph C. Smith, Smart material systems: model development, siam, 2005.
5. Vijay K. Varadan, Smart material systems and MEMS: design and development methodologies, John Wiley & Sons, 2006.
6. Seung- Bok Choi & Young-Min Han, Piezoelectric actuators: control applications of smart materials, CRC Press - 2010.
7. Antonio Arnau, Piezoelectric transducers and applications, Springer, 2004.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	2	-	-	-	-	-	-	2	3	1	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3
CO3	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO4	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO5	3	2	2	3	2	-	-	-	-	-	-	2	3	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTP6 MECHATRONICS IN MANUFACTURING SYSTEMS

COURSE LEARNING OBJECTIVES:

The objective of this course is to:

1. Understand characteristics and the components of mechatronics systems
2. Discuss recent trends in mechatronics
3. Describe active & passive electrical circuits

4. Describe the techniques are of used to design a mechatronics process.
5. Suggest possible design solutions

COURSE CONTENTS

Module 1

Introduction to mechatronics, need of mechatronics in measurement systems, control systems, traditional design.

Module 2

Feedback devices, introduction of sensors and transducers, performance terminology, displacement, position and proximity, velocity and motion, fluid pressure, temperature sensors - light sensors, selection of sensors, signal processing, servo systems.

Module 3

Role of microprocessors in mechatronics, introduction of microprocessors and microcontrollers , pin configuration, instruction set, programming of microprocessors using 8085 instructions , interfacing input and output devices, interfacing D/A converters and A/D converters , applications - temperature control, stepper motor control, traffic light controller.

Module 4

Programmable logic controllers (PLC), introduction, basic structure, input/output processing, programming, mnemonics timers, internal relays and counters, data handling, analog input/output, selection of PLC.

Module 5

Design and mechatronics, designing, possible design solutions, case studies of mechatronics systems.

COURSE OUTCOMES:

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

1. Identification of key elements of mechatronics system and its representation in terms of block diagram.
2. Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
3. Interfacing of sensors, actuators using appropriate DAQ micro-controller.
4. Time and Frequency domain analysis of system model (for control application).
5. PID control implementation on real time systems .
6. Development of PLC ladder programming and implementation of real life system.

Text & Reference Books:

1. Histand Michael B. and Alciatore David G., “Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ, "Mechatronics ", Chapman and Hall, 1993.
3. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications” Wiley Eastern, 1998.

4. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics", Prentice-Hall, 2000.

5. Ghosh P.K. and Sridhar, P.R., "Introduction to Microprocessors for Engineers and Scientists, (0000 to 8085)", Second Edition, Prentice Hall, 2004.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs)

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	1	-	-	-	-	-	-	-	3	1	-
CO2	3	2	2	3	1	-	-	-	-	-	-	-	2	3	-
CO3	3	2	2	1	2	-	-	-	-	-	-	-	1	2	2
CO4	3	1	1	3	1	-	1	-	-	-	-	-	2	1	1
CO5	3	3	2	1	1	-	-	-	-	-	-	-	1	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBTO1 **IPPBTO2** **IPPBTO3** **IPPBTO4** **IPPBTO5** **IPPBTO6** **IPPBTO7** **IPPBTO8**	**Open Elective** **1. Business Analytics** **2. Industrial Safety** **3. Operations Research** **4. Cost Management of Engineering Projects** **5. Composite Materials** **6. Waste to Energy** **7. Production management** **8. MOOCs**	**3**	**0**	**0**	**40**	**60**	**100**	**3**

IPPBTO1 BUSINESS ANALYTICS

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

COURSE CONTENTS

Module 1

Business analytics: Overview of business analytics, scope of business analytics, business analytics process, relationship of business analytics process and organisation, competitive advantages of business analytics. statistical tools: statistical notation, descriptive statistical methods, review of probability distribution and data modelling, sampling and estimation methods overview.

Module 2

Trendiness and regression analysis: Modelling relationships and trends in data, simple linear regression. important resources, business analytics personnel, data and models for business analytics, problem solving, visualizing and exploring data, business analytics technology.

Module 3

Organization structures of business analytics, team management, management issues, designing information policy, outsourcing, ensuring data quality, measuring contribution of business analytics, managing changes. descriptive analytics, predictive analytics, predicative modelling, predictive analytics analysis, data mining, data mining methodologies, prescriptive analytics and its step in the business analytics process, prescriptive modelling, nonlinear optimization.

Module 4

Forecasting techniques: Qualitative and judgmental forecasting, statistical forecasting models, forecasting models for stationary time series, forecasting models for time series with a linear trend, forecasting time series with seasonality, regression forecasting with casual variables, selecting appropriate forecasting models.

Monte Carlo simulation and risk analysis: Monte Carlo simulation using analytic solver platform, new-product development model, newsvendor model, overbooking model, cash budget model.

Module 5

Decision analysis: Formulating decision problems, decision strategies with the without outcome probabilities, decision trees, the value of information, utility and decision making.

Module 6

Recent trends in embedded and collaborative business intelligence, visual data recovery, data storytelling and data journalism.

COURSE OUTCOMES:

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

1. Knowledge of data analytics.
2. Think critically in making decisions based on data and deep analytics.
3. Use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Translate data into clear, actionable insights.
5. Knowledge of embedded and collaborative business intelligence, data journalism.

Text Books & References

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	2	1	-	-	-	-	-	-	-	-	2	-	-
CO3	3	1	2	1	-	-	-	-	-	-	-	-	3	-	2
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	1	1
CO5	3	1	-	-	-	-	-	-	-	-	-	-	2	1	1

1-Sightly (Low); 2-Moderately (Medium); 3-Strongly (High)

IPPBTO2 INDUSTRIAL SAFETY

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To develop an understanding of the principles of safety, terminologies in accident prevention and its theories.
2. To understand the theory and practice of occupational health, ergonomics and hygiene, principle of fire engineering and firefighting.
3. To understand the theory and practice of Fault tracing-concept in failure of mechanical and electrical equipment.

COURSE CONTENTS

Module 1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Module 2

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Module 3

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors

affecting the corrosion. Types of corrosion, corrosion prevention methods.

Module 4

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Module 5

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

COURSE OUTCOMES:

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

1. Identify the various possible hazards in different fields of engineering. Remember (level1)
2. Students will be able to classify various hazards based on their nature and severity. Understand (level 2)
3. Students will be able to use the knowledge gained for maintaining safety, occupational health and hygiene in an industry and Apply (level 3)
4. Students will be able to examine the factors that lead to an accident. Analyse (level 4)
5. Students will be able to select the safety equipment to be used for prevention of various hazards. Evaluate (level 5)
6. Students will be able to plan the safety measures appropriate for an industry. Create (level 6)

Text Books & References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs 1	PSOs 2	PSOs 3

CO1	-	3	3	2	2	3	3	-		-	2		3	-	-
CO2	-	3	3	2	2	3	2	2		-	2		3	-	-
CO3	-	3	2	2	2	2	-	-		-	2		2		
CO4	3	3	2	2	-	2	2	-		-	2		3		
CO5	3	3	-	3	-	1	-	1		-	2		2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTO3 OPERATIONS RESEARCH

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To understand various techniques and modeling concepts that can be used to analyze and design complex systems.
2. To compile the basic concepts of LPP and various solving techniques.
3. To make use of inventory models, project evaluation models, and various allied techniques.
4. To illustrate the importance of scheduling and sequencing and its application in the real world.
5. To define optimization methods, programming, and game conception towards problem solving.

COURSE CONTENTS

Module 1

Optimization techniques, model formulation, models, general L.R formulation, simplex techniques, sensitivity analysis, inventory control models.

Module 2

Formulation of a LPP, graphical solution revised simplex method, duality theory, dual simplex method, sensitivity analysis, parametric programming.

Module 3

Nonlinear programming problem, Kuhn-Tucker conditions min cost flow problem, max flow problem, CPM/PERT.

Module 4

Scheduling and sequencing, single server and multiple server models, deterministic inventory models, probabilistic inventory control models, geometric programming.

Module 5

Competitive models, single and multi-channel problems, sequencing models, dynamic programming, flow in networks, elementary graph theory, game theory simulation.

COURSE OUTCOMES:

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

1. Apply the dynamic programming to solve problems of discreet and continuous variables.
2. Apply the concept of non-linear programming
3. Carry out sensitivity analysis

4. Model the real world problem and simulate it.

Text Books and References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1	-	-	-	2	-	3	3	3	3
CO2	2	-	2	2	2	2	-	-	-	1	-	2	3	2	3
CO3	2	2	3	2	2	-	-	-	-	-	-	2	-	2	3
CO4	3	3	2	2	2	2	-	-	-	1	-	2	2	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTO4 COST MANAGEMENT OF ENGINEERING PROJECTS

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Develop knowledge of phases in cost management.
2. Develop the idea of project execution.
3. Knowing the team required for project management.
4. Able to implement tools available for project management and its performance measurement.

COURSE CONTENTS

Module 1

Introduction and overview of the strategic cost management process.

Module 2

Cost concepts in decision-making; relevant cost, differential cost, incremental cost and opportunity cost. Objectives of a costing system; inventory valuation; creation of a database for operational control; provision of data for decision-making.

Module 3

Project: meaning, different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed engineering activities. Pre-project execution main clearances and

documents project team: role of each member. Importance project site: data required with significance.

Project contracts. Types and contents. Project execution project cost control. Bar charts and network diagram. Project commissioning: mechanical and process

Module 4

Cost behavior and profit planning marginal costing; distinction between marginal costing and absorption costing; break-even analysis, cost-volume-profit analysis. Various decision-making problems. Standard costing and variance analysis. Pricing strategies: Pareto analysis. Target costing, life cycle costing. Costing of service sector. Just-in-time approach, material requirement planning, enterprise resource planning, total quality management and theory of constraints. Activity-based cost management, bench marking; balanced score card and value-chain analysis. Budgetary control;

flexible budgets; performance budgets; zero-based budgets. measurement of divisional profitability pricing decisions including transfer pricing.

Module 5

Quantitative techniques for cost management, linear programming, PERT/CPM, transportation problems, assignment problems, simulation, learning curve theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs1	PSOs2	PSOs3
CO1	3	2	3	2	2	-	2	-	2	-	2	2	3	2	3
CO2	3	3	3	2	2	3	2	2	2	-	2	-	3	2	2
CO3	3	3	2	2	2	2	-	-	2	-	2	2	2	3	-
CO4	3	3	2	2	-	2	2	-	2	-	2	2	3	2	-
CO5	3	3	-	3	-	1	-	1	2	-	2	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTO5 COMPOSITE MATERIALS

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Give students practice in applying their knowledge of linear elasticity to the vast area of composites.
2. Build the concept of anisotropic, isotropic and orthotropic material behaviour and its

application in the analysis and design of laminated structural components.

3. Prepare the students for broader applications of composite materials for developing the light weight structures.
4. Enlarge the student's knowledge in composite materials and their macro/micro mechanical properties.
5. Empower the students with the skills needed for the design, manufacture and analysis of composite materials from a material scientist's viewpoint.

COURSE CONTENTS

Module 1

Introduction: Definition, classification and characteristics of composite materials.

Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Module 2

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical behavior of composites. Rule of mixtures, inverse rule of mixtures. Isostrain and isostress conditions.

Module 3

Manufacturing of metal matrix composites: Casting – solid state diffusion technique.

Cladding: Hot isostatic pressing, properties and applications, manufacturing of ceramic matrix.

Composites: Liquid metal infiltration – liquid phase sintering, manufacturing of carbon–carbon composites: knitting, braiding, weaving, properties, and applications.

Module 4

Manufacturing of polymer matrix composites: Preparation of moulding compounds and prepregs, hand layup method, autoclave method, filament winding method, compression moulding, reaction injection moulding, properties and applications.

Module 5

Strength: Laminar failure criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. laminate first play failure-insight strength; laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

COURSE OUTCOMES

At the end of the course, students will be able to

1. Explain and also implement the composite materials for the required performance based on the characteristics.
2. Adopt the composite materials as reinforcements

3. Implement the methods of manufacturing of metal matrix composites.
4. Adopt the methods of manufacturing of polymer matrix composites.
5. Evaluate the strength of laminates.

Texts and References:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3
CO3	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO4	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

PPBTO6 WASTE TO ENERGY

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand the principles associated with effective energy management and to apply these principles in the day-to-day life.
2. Develop insight into the collection, transfer and transport of municipal solid waste.
3. Explain the design and operation of a municipal solid wasteland fill.
4. Device key processes involved in recovering energy from wastes, systematically evaluate the main operational challenges in operating thermal and biochemical energy from waste facilities.

COURSE CONTENT

Module 1

Introduction to energy from waste: Classification of waste as fuel , agro based, forest residue, industrial waste, MSW, conversion devices, incinerators, gasifiers, digestors.

Module 2

Biomass pyrolysis: Pyrolysis, types, slow fast, manufacture of charcoal, methods, yields and application, manufacture of pyrolytic oils and gases, yields and applications.

Module 3

Biomass gasification: Gasifiers, fixed bed system, downdraft and updraft gasifiers, fluidized bed gasifiers, design, construction and operation, gasifier burner arrangement for thermal heating, gasifier engine arrangement and electrical power, equilibrium and kinetic consideration in gasifier operation.

Module 4

Biomass combustion: Biomass stoves, improved chullahs, types, some exotic designs, fixed bed combustors, types, inclined grate combustors, fluidized bed combustors, design, construction and operation, operation of all the above biomass combustors.

Module 5

Biogas: Properties of biogas (Calorific value and composition), biogas plant technology and status, bio energy system, design and constructional features, biomass resources and their classification, biomass conversion processes, thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas plants, applications, alcohol production from biomass, bio diesel production, urban waste to energy conversion, biomass energy programme in India.

COURSE OUTCOMES:

1. Describe basic concepts of waste to energy resources and their conversion devices.
2. Understand the concept of pyrolysis and the production of different products by using pyrolysis.
3. Explore different types of biomass gasification techniques and understand Biochemical conversion of biomass for energy application.
4. Explore different types of biomass combustion techniques and their working operations.
5. Describe the basic concepts of biogas and explore biogas plant technology and their applications.

Texts and References:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3

CO3	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO4	3	2	2	3	2	-	-	-	-	-	-	2	3	1	3
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3	1	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

PRODUCTION MANAGEMENT

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To develop and apply mathematics & engineering skills to identify, formulate, and solve industrial process problems.
2. To introduce the concept of organization, production systems and cost analysis.
3. To resolve the problems and opportunities faced by the operations manager in manufacturing and service organizations.
4. To develop an ability to apply PPC concepts in a various areas like marketing, accounting, finance, engineering, personnel management, logistics, etc.
5. To integrate operations concepts with other functional areas of business.
6. To understand the PPC function in both manufacturing and service organizations.
7. To examine several classic operations management planning topics including production planning and inventory control.
8. To learn several important contemporary topics relevant to business managers of all functional disciplines, including quality management, lean concepts, and sustainability.

COURSE CONTENT

Module 1

Introduction: Introduction to various types of production system viz. mass production, job shop, batch production system, continuous production system, concept of production and operation management, objective & functions of PPC.

Forecasting: Time series method, moving average, weighted average, trend, seasonality, regression technique, Delphi method.

Module 2

Aggregate planning: Definition, strategies, pure and mixed strategies, methods.

Master production schedule: objective and functions, design of MPS, bill of materials.

Material requirement planning: objectives, functions, MRP, MRP-II, limitations.

Capacity requirement planning: Definition, objectives, process of CRP, process sheet, rough cut capacity planning, loading, and preparation of CRP chart.

Module 3

Scheduling: Types, single machine scheduling, job shop scheduling, flow scheduling;

Sequencing: various priority rules; line of balancing: rank and positional weight method, Kilbridge Westner method.

Facility location and facility location problems: Factors affecting plant locations, single facility locations problems and its methods.

Module 4

Types of layout- layouts design procedure such as CORELAP, CRAFT etc., material handling system & their classification, principles. JIT & KANBAN, depreciation & methods of depreciation.

Module 5

Maintenance management: Types of maintenance strategies, breakdown and preventive maintenance, predictive and total productive maintenance, condition monitoring, individual and group replacement policies. make or buy decision, concept of original equipment effectiveness.

COURSE OUTCOMES:

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

1. Recognize the objectives, functions, applications of PPC and forecasting techniques.
2. Explain different Inventory control techniques.
3. Solve routing and scheduling problems.
4. Summarize various aggregate production planning techniques.
5. Describe way of integrating different departments to execute PPC functions.
6. Develop sustainable organization structure, production systems.
7. Determine appropriate methods of sales forecasting and cost analysis.

Text Books & References

1. Production and operation management, O.Paneerselvem, TMH.
2. Production and operation management, Adem Ebert
3. Production and operation management, Charry S.N. TMH
4. Production and operations management Theory and practice Mahadevan.B
5. Production and operation management, Joseph .G. Monks, TMH
6. Handbook of Material Handling, Ellis Horwood limited
7. Operations Management: Design Planning and control for the manufacturing and services
8. Lawrence.P.Atkin, James B. Dilworth Tata Mc Graw Hill
9. Production and Operations management, R.B Khanna, PHI.
10. Production operations management S.N.Buffa, PHI.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	2	1	-	-	-	-	2	-	3	2	2	2

CO2	3	3	2	3	2	-	-	1	-	2	3	2	3	3	3
CO3	3	3	2	3	2	-	-	2	-	2	3	3	3	2	3
CO4	3	2	3	2	2	2	-	-	2	2	-	2	3	3	3
CO5	3	3	2	1	3	2	-	-	-	2	-	3	2	3	3
CO6	3	2	3	2	2	3	-	-	-	-	-	3	2	2	3
CO7	3	3	3	2	3	3	-	-	2	2	-	2	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBTX1 **IPPBTX2** **IPPBTX3** **IPPBTX4** **IPPBTX5** **IPPBTX6** **IPPBTX7** **IPPBTX8**	**Audit Course-I** **1. English for Research Paper Writing** **2. Disaster Management** **3. Sanskrit for Technical Knowledge** **4. Value Education** **5. Constitution of India** **6. Pedagogy Studies** **7. Stress Management by Yoga** **8. Personality Development through Life Enlightenment Skills.**	**2**	**0**	**0**	**40**	**60**	**100**	**2**

IPPBTX1 ENGLISH FOR RESEARCH PAPER WRITING

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand how to improve your writing skills and level of readability

2. Learn about what to write in each section

3. Understand the skills needed when writing a Title

COURSE CONTENTS

Module 1

Planning and preparation, word order, breaking up long sentences, structuring paragraphs and sentences, being concise and removing redundancy, avoiding ambiguity and vagueness.

Module 2

Clarifying who did what, highlighting your findings, hedging and criticising, paraphrasing and plagiarism, sections of a paper, abstracts, introduction.

Module 3

Review of the literature, methods, results, discussion, conclusions, the final check. key skills are needed when writing a title, key skills are needed when writing an abstract, key skills are needed when writing an introduction, skills needed when writing a review of the literature.

Module 4

Skills are needed when writing the methods, skills needed when writing the results, skills are needed when writing the discussion, skills are needed when writing the conclusions.

Module 5

Useful phrases how to ensure paper is as good as it could possibly be the first- time submission.

COURSE OUTCOMES:

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

1. Student will be able to improve your writing skills and level of readability
2. Student will learn about what to write in each section
3. Student will understand the skills needed when writing a Title

Text & Reference Books

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific

COs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOs 1	PSOs 2	PSOs 3
CO1	-	2	3	2	1	2	3	1	1	2	2	1	3	2	2
CO2	-	3	3	3	1	3	3	1	1	2	2	2	2	2	2
CO3	-	2	1	2	1	2	3	2	1	2	3	2	3	2	3

Outcomes (PSOs):

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTX2 DISASTER MANAGEMENT

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

COURSE CONTENTS

Module 1

Introduction: Disaster, definition, factors and significance; difference between hazard and disaster, natural and manmade disasters: difference, nature, types and magnitude.

Module 2

Repercussions of disasters and hazards: Economic damage, loss of human and animal life, destruction of ecosystem. natural disasters: earthquakes, volcanisms, cyclones, tsunamis, floods, droughts and famines, landslides and avalanches, man-made disaster: nuclear reactor meltdown, industrial accidents, oil slicks and spills, outbreaks of disease and epidemics, war and conflicts.

Module 3

Disaster prone areas in India: Study of seismic zones; areas prone to floods and droughts, landslides and avalanches; areas prone to cyclonic and coastal hazards with special reference to tsunami; post-disaster diseases and epidemics.

Module 4

Disaster and management preparedness: Monitoring of phenomena triggering a disaster or hazard; evaluation of risk: application of remote sensing, data from meteorological and other agencies, media reports: governmental and community preparedness.

Module 5

Risk assessment disaster risk: Concept and elements, disaster risk reduction, global and national disaster risk situation. techniques of risk assessment, global co-operation in risk assessment and warning, people's participation in risk assessment. strategies for survival.

Module 6

Disaster mitigation: Meaning, concept and strategies of disaster mitigation, emerging trends in mitigation. structural mitigation and non-structural mitigation, programs of disaster mitigation in India.

COURSE OUTCOMES:

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

1.Learn definitions of disaster and hazard also man-made hazard.

2.Have knowledge of loss of human and animal life, destruction of ecosystem.

3. Study of seismic zones; post-disaster diseases and epidemics.

4. Monitor of phenomena triggering a disaster or hazard; evaluation of risk.

5.Learn concept and elements, disaster risk reduction, global and national.

Text & Reference Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	1	1	-	-	-	-	-	-	-	-	-	2	-	2
CO4	3	1	1	-	-	-	-	-	-	-	-	-	2	1	2
CO5	3	1	-	1	2	-	-	-	-	-	-	-	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTX3 SANSKRIT FOR TECHNICAL KNOWLEDGE

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world.
2. Learning of Sanskrit to improve brain functioning.
3. Learning of Sanskrit to develop logic in mathematics, science, and other subjects and will boost memory power.
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

COURSE CONTENTS

Module 1

Sanskrit alphabets, past/present/future tense, simple sentences.

Module 2

order, introduction of roots, technical information about Sanskrit literature.

Module 3

Technical concepts of engineering-electrical, mechanical, architecture, mathematics.

COURSE OUTCOMES:

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

1. Knowledge of Sanskrit and allied sentences.
2. Understand the importance of Sanskrit literatures.
3. Develop the understanding of technical concept to attain overall personality.

Text & Reference Books:

1. “Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.

3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	1	-	-	-	2	3	2	-	3	1	-	-
CO2	1	-	-	2	-	-	-	2	2	2	-	2	1	-	-
CO3	1	-	-	2	1	-	-	2	2	2	-	3	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTX4 VALUE EDUCATION

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand value of education and self- development.
2. Imbibe good values in students.
3. Know about the importance of character.

COURSE CONTENTS

Module 1

Values and self-development, social values and individual attitudes, work ethics, Indian vision of humanism, moral and non- moral valuation, standards and principles, value judgements

Module 2

Importance of cultivation of values, sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanliness, honesty, humanity, power of faith, national unity, patriotism, love for nature, discipline.

Module 3

Personality and behavior development: Soul and scientific attitude, positive thinking, integrity and discipline, punctuality, love and kindness, avoid fault thinking, free from anger, dignity of labour, universal brotherhood and religious tolerance, true friendship, happiness vs suffering, love for truth, aware of self-destructive habits, association and cooperation, doing best for saving nature,

Module 4

Character and competence: Holy books vs blind faith, self-management and good health, science of reincarnation, equality, nonviolence, humility, role of women, all religions message, mind your mind, self-control, honesty, studying effectively.

COURSE OUTCOMES:

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

1. Knowledge of self-development.
2. Learn the importance of human values.

3. Development of the overall personality.

Text & Reference Books:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	1	-	-	-	3	3	3	-	3	2	-	2
CO2	1	-	-	-	-	-	-	3	3	3	-	2	1	-	-
CO3	1	-	-	1	1	-	-	3	3	3	-	3	2	-	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTX5 CONSTITUTION OF INDIA

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Module 1

History of making of the Indian constitution: History drafting committee, (composition & working) philosophy of the Indian constitution: preamble salient features

Module 2

Contours of constitutional rights & duties: Fundamental rights- right to equality, right to freedom, right against exploitation, right to freedom of religion, cultural and educational rights, right to constitutional remedies, directive principles of state policy, fundamental Duties.

Module 3

Organs of governance: Parliament, composition, qualifications and disqualifications, powers and functions, executive, President, Governor, council of ministers, judiciary, appointment and transfer of judges, qualifications, powers and functions.

Module 4

Local administration: District's administration head, role and importance. Municipalities: Introduction, Mayor and role of elected representative, CEO of municipal corporation. Pachayati Raj: Introduction, PRI: Zila pachayat, elected officials and their roles, CEO zila pachayat: Position and role. Block level: organizational hierarchy (different departments), village level: role of elected and

appointed officials, importance of grass root democracy.

Module 5

Election Commission: Election commission, role and functioning, chief election commissioner and election commissioners, state election commission: role and functioning. Institute and bodies for the welfare of SC/ST/OBC and women.

COURSE OUTCOMES:

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

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the congress socialist party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

Text & Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.

2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.

3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	2	1	-	-	-	3	3	3	-	3	2	-	2
CO2	-	-	2	-	-	-	-	2	1	3	-	2	1	2	-
CO3	-	-	2	1	1	-	-	3	2	3	-	3	2	-	3
CO4	-	1	1	-	-	1	-	2	2	-	-	2	1	2	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTX6 PEDAGOGY STUDIES

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

COURSE CONTENTS

Module 1

Introduction and methodology: Aims and rationale, policy background, conceptual framework and terminology. Theories of learning, curriculum, teacher education, conceptual framework, research

questions**,** overview of methodology and searching. Thematic overview: pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, curriculum, teacher education.

Module 2

Evidence on the effectiveness of pedagogical practices, methodology for the in-depth stage: quality assessment of included studies, how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy, theory of change, strength and nature of the body of evidence for effective pedagogical practices, pedagogic theory and pedagogical approaches, teachers' attitudes and beliefs and pedagogic strategies.

Module 3

Professional development: Alignment with classroom practices and follow-up support, peer support, support from the head teacher and the community, curriculum and assessment. Barriers to learning: limited resources and large class sizes.

Module 4

Research gaps and future directions: Research design, contexts, pedagogy, teacher education, curriculum and assessment, dissemination and research impact.

COURSE OUTCOMES:

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

1. Analyze the pedagogical practices being used by teachers in formal and informal classrooms in developing countries.
2. Learn about the evidence on the effectiveness of these pedagogical practices, in what conditions, and to what population of learners.
3. Know about teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
4. Able to find the research gap.
5. How to get the research impact for future?

Text & Reference Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational
5. Development, 33 (3): 272–282.
6. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and

Boston: Blackwell.

7. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

8. www.pratham.org/images/resource%20working%20paper%202.pdf.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	1	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTX7 STRESS MANAGEMENT BY YOGA

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To achieve overall health of body and mind

2. To overcome stress

COURSE CONTENTS

Module 1

Definitions of Eight parts of yog. (Ashtanga)

Module 2

Yam and Niyam, Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module 3

Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

COURSE OUTCOMES:

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

1. Develop healthy mind in a healthy body thus improving social health also

2. Improve efficiency

Text & Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	1	-	-	1	2	2	-	1	-	-	-
CO2	-	-	1	-	-	-	-	2	1	2	-	2	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

IPPBTX8 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

COURSE CONTENTS

Module 1

Neetisatakam-Holistic development of personality: Verses- 19, 20, 21, 22 (wisdom); Verses- 29, 31, 32 (pride & heroism); Verses- 26,28,63,65 (virtue); Verses- 52,53,59 (dont's); Verses- 71,73,75,78 (do's).

Module 2

Approach to day to day work and duties: Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48; Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35; Chapter 18-Verses 45, 46, 48.

Module 3

Statements of basic knowledge: Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68; Chapter 12 -Verses 13, 14, 15, 16,17, 18.

Personality of Role model: Shrimad Bhagwad Geeta-Chapter2-Verses 17, Chapter 3-Verses 36,37,42; Chapter 4-Verses 18, 38,39; Chapter18 – Verses 37,38,63.

COURSE OUTCOMES:

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

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

Text & Reference Books:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	2	-	-	-	2	3	3	-	3	2	-	1
CO2	1	-	-	2	-	-	-	3	1	3	-	2	1	2	1
CO3	2	-	1	2	1	-	-	1	3	3	-	3	2	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBPT1	**Mini Project**	**0**	**0**	**4**	**30**	**20**	**50**	**2**

IPPBPT1 MINI PROJECT

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. To develop design skills according to a Conceive-Design-Implement Operate (CDIO) compliant methodology.
2. To implement engineering skill and knowledge to complete the identified project work while encouraging creativity and innovation.
3. To develop spirit of team work, communication skills through group-based activity and foster self- directing learning and critical evaluation.

COURSE OUTCOMES:

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

1. Identify a problem based on the need analysis of community /industry/ research.
2. Create a flowchart of methodology for solving the identified problem
3. Demonstrate team work with work division, team meetings and communications among team members.
4. Write technical report for the project work and present the same through power point presentations or posters.

Course Code	Subjects	Periods/Week			Evaluation			Credits
		L	T	P	IA	ESE	Total	
IPPBLT1	**Robotics lab**	**0**	**0**	**4**	**30**	**20**	**50**	**2**

IPPBLT1 ROBOTICS LAB

COURSE LEARNING OBJECTIVES:

The objective of this course is to

1. Learn about force and torque sensing
2. Learn about application of robot
3. Apply the basic engineering
4. The drive systems used in Industrial applications
5. Simulation Software for Industrial Robots

List of Experiments:

(1) Assignment on introduction to robot configuration

(2) Demonstration of robot with 2 dof, 3 dof, 4 dof etc.

(3) Two assignments on programming the robot for applications

(4) Two assignments on programming the robot for applications

(5) Two programming exercises for robots

(6) Two case studies of applications in industry

(7) Exercise on robotic simulation software

COURSE OUTCOMES:

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

CO1: Develop Ladder diagrams for PLC Programming

CO2: Work with simple Automation Systems using PLC

CO3: Analyze Forward and Inverse Kinematics for Basic Robots

CO4: Programming and Analysis of Industrial Robots using Software

CO5: Visualize the configurations of various types of robots.

CO6: Describe the components of robots like arms, linkages, drive systems and end effectors.

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs**												**PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	2	1	-	-	-	-	-	-	2	3	2	1
CO2	3	1	-	2	1	-	-	-	-	-	-	1	2	2	1
CO3	3	1	-	2	1	-	-	-	-	-	-	2	3	2	1
CO4	3	1	-	2	1	-	-	-	-	-	-	2	3	2	2
CO5	3	1	-	2	1	-	-	-	-	-	-	2	3	2	2
CO6	3	1	-	2	1	-	-	-	-	-	-	2	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)