8th SEMESTER SYLLABUS

BE SEMESTER VIII

Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)

TCET Autonomy Scheme (w.e.f. A.Y. 2020-21)

B.E. (Mechanical Engineering)							**B.E. SEM :** VIII		
Course Name : CAD-CAM – FEM							**Course Code :PCC- ME801**		
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory (100)**		**Practical/Oral (25)**	**Term Work (25)**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR/OR**	**TW**	
3		2	5	4	25	75	-	25	**125**
IA: Mid Semester Assessment- Paper Duration – **1.5 Hours** **ESE :** End Semester Evaluation- Paper Duration - **3 Hours** The weightage of marks for continuous evaluation of Term work / Report: Formative (40%), Timely completion of practical (40%) and Attendance (20%)									
Prerequisite: Comuter Aided Design, Manufacturing process – I.									

Course Objectives:

This course intends to deals with the fundamentals of CAD – CAM and FEM including To learn graphics software (ii) To perform various CAD modelling, 2D – 3D transportation, basics of NC , CNC and turning and milling programming, to get the knowledge of finite element analysis, recent trends in industry.

Course Outcomes:

SN	Course Outcomes	Cognitive levels as per bloom's Taxonomy
1	Integrate the role of graphic communication in the engineering design process.	L1, L2, L3, L4
2	Generate various curves and surfaces using Computer graphics.	L1 ,L2, ,L3, L,4
3	To demonstrate a basic understanding of machining fundamentals including speed and feed calculations, tooling systems, and work-holding systems for CNC milling and turning equipment	L1, L2, L3, L6
4	Demonstrate the importance of Automation of machine components.	L1, L2
5	Enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis	L1, L2, L3, L4, L5
6	Able to understand the smart factory maximize outcomes in industry 4.0 and RP.	L1, L2

Detailed Syllabus:

Module No.	Topics	Hrs.	Cognitive levels as per bloom's Taxonomy
1	**Computer graphics:** **Introduction to computer graphics:** CAD/CAM hardware and software, Scope of CAD/CAM in product life cycle. **Transformations:** meaning of transformation, 2D & 3D, Homogenous representation, concatenated transformations, viewing transformation.	8	L1, L2,L3
2	**Geometric modeling :** **Parametric representation of curves and surfaces:** Synthetic Curves , Bezier curves, Hermite Curves, B-spline curves. Surface representation. **Solid Modeling:** Constructive solid geometry (CSG), Boundary Representation (BRep), Wire Frame Modeling, Solid Modeling, Surface Modeling, Parametric Modeling, Feature based modeling, Constraint Based Modeling.	10	L1,L2,L3,L4
3	**Computer Aided Manufacturing:** **Introduction to CNC:** Need of CNC machines, NC, CNC and DNC systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. **CNC programming of motions:** CNC programming such as types of motions, cutter compensations, work offsets, coordinate transformations, canned cycles, subprograms, macros etc. Programming examples and exercises for lathes and milling machines	9	L1,L2,L3,L6
4	**Computer integrated Manufacturing and Flexible Manufacturing System:** **CIM:** -Introduction to CIMS, nature, types of manufacturing system, evaluation, CIMS hardware and software, benefits, scope and needs, CIMS wheel, elements of CIMS and their role, computer technology and manufacturing, database requirement. **FMS:** Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type. Layouts and their Salient features, Single line, dual line, loop, ladder, robot centre type etc.	5	L1,L2
5	**Finite Element Method:** **Introduction:** Historical Background, General FEM procedure, Applications of FEM, Mathematical Modelling of field problems in engineering, Governing equations, Differential equations in different fields, Approximate solution of differential equations, Weighted residual techniques, Boundary value problems. **Finite element Method problems:** One Dimensional Problems, two Dimensional Problems, Solutions techniques to Dynamic problems.	8	L1,L2LL3,L4
6	**Recent trends in industry :** **Rapid Prototyping:** Introduction to RP, RP Methods, Stereo lithography, Fused-deposition modeling, Selective laser sintering, Laminated-object manufacturing, Ballistic particle Manufacturing, Solid-base curing. **Industry 4.0:** Introduction to Industry 4.0 , difference between industry 4.0 and Industry 3.0. requisition of Industry 4.0.	5	L1, L2, L3

Books and References:

SN	Title	Authors	Publisher	Edition	Year
1	"CNC Machines",	Pabla B.S., Adithan M..	New Age International , New Delhi	2nd	2014
2	"CAD/CAM: computer aided design and manufacturing",	Groover, M. P., Zimmer, W.E	Prentice Hall	3rd	2014
3	"Computer Aided Manufacturing."	Rao, P. N., Tiwari, N. K., Kundra, T.	CBS Publ. N-Delhi	3rd	1995
4	CAD/CAM and Automation	Farzadak Haideri	Nirali Publication	2nd	2016
5	" Automation, production Systems and Computer Integrated Manufacturing,"	Mikell P Groover	Prentice Hall Inc.	3rd	2007
6	"Rapid prototyping Technology : Selection and application"	Cooper, K.G.,	CRC press	-	2012
7	An Introduction to the Finite Element Method	J. N. Reddy	Tata McGraw-Hill	2nd	2001
8	Mathematical Elements for Computer Graphics	David F. Rogers and J. Alan Adams	Tata McGraw-Hill Edition	2nd	2004

Suggested List of Experimnet

Practica	Type of Experiment	Practical/Experiment Topic	Hrs.	Cognitive levels as Taxonomy
01	Design Experiments	Experiment on solid modelling using Solid work or Catia	02	L1, L2, L3
02		Experiment on 2D transformation through Matlab or Scilab	02	L1, L2, L3
03		Experiment on 3D transformation through Matlab or Scilab	02	L1, L2, L3
04		Experiment on CNC Programming - Lathe	04	L1, L2, L3
05		Experiment on CNC Programming on Simple Milling operations - I	02	L1, L2, L3
06		Experiment on CNC Programming on Simple Milling operations - II	02	L1, L2, L3
07		Experiment of 1D and 2D on Ansysis Software.	02	L1, L2, L3, L4
08		Experiment on 3D printing machine – Simple geometry	02	L1, L2, L3,
09		Experiment on 3D printing machine – complex geometry	02	L1, L2, L3,
10	Mini/Minor/Projects/Case	Case study : Typical FMS problems from research paper.	02	L1, L2, L3 ,

BE SEMESTER VIII

Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)

TCET Autonomy Scheme (w.e.f. A.Y. 2020-21)

B.E. (Mechanical Engineering)							**B.E. SEM:** VIII		
Course Name: Design of Mechanical Systems							**Course Code:** PEC- ME8011		
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory**		**Practical/Oral**	**Term Work**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR/ OR**	**TW**	
3	-	2@	5	4	25	75	25	25	**150**
IA: In-Semester Assessment- Paper Duration-**1** **Hours ESE :** End Semester Examination - Paper Duration - **3 Hours** **The weightage of marks for continuous evaluation of Term work/Report:** Formative (40%), Timely completion of practical (40%) and Attendance (20%)									
Prerequisite: Basic Design Concepts and theories of failure.									

Course Objectives: Course intend to acquaint with system design of various systems such as snatch block, belt conveyors, engine system, pumps and machine tool gearbox

Course Outcomes:

SN	Course Outcomes	Cognitive levels as per bloom's Taxonomy
1	Apply the concept of system design.	L1, L2, L3, L4
2	Design material handling systems such as hoisting mechanism of EOT crane,	L1, L2, L3, L4
3	Design belt conveyor systems	L1, L2, L3, L4
4	Design engine components such as cylinder, piston, connecting rod and crankshaft	L1, L2, L3, L4
5	Design pumps for the given applications	L1, L2, L3, L4
6	Prepare layout of machine tool gear box and select number of teeth on each gear	L1, L2, L3, L4

Detailed Syllabus:

Module No.	Topics	Hrs.	Cognitive levels as per bloom's
1	**Introduction** Methodology & Morphology of design, Optimum design, system concepts in design.	4	L1, L2, L3, L4
2	**Design of hoisting mechanism** Design of Snatch Block Assembly including Rope Selection, Sheave, Hook, Bearing for hook, cross piece, Axle for sheave and shackle plate, Design of rope drum, selection motor with transmission system.	9	L1, L2, L3
3	**Design of belt conveyors** Power requirement, selection of belt, design of tension take up unit, idler pulley	6	L1, L2, L3

4	**Engine Design (Petrol and Diesel)** Design of cylinder, Piston with pin and rings, connecting rod & crank shaft with bearings	8	L1, L2, L3, L4
	Design of Pumps 5.1 Design of main components of gear pump. 1 Motor selection 2 Gear design 3 Shaft design and bearing selection 4 Casing and bolt design 5 Suction and delivery pipe		
6	**Design of Gear Box** Design of gear boxes for machine tool applications(Maximum three stages and twelve speeds), Requirements of gear box, determination of variable speed range, graphical representation of speeds, structure diagram, ray diagram, selection of optimum ray diagram, estimation of numbers of teeth on gears, deviation diagram, layout of gear box	8	L4

Online References:

S.	Website Name	URL	Modules
1	www.nptel.ac.in	https://nptel.ac.in/courses/112/105/112105125/	M1- M6

Books and References:

SN	Title	Authors	Publisher	Edition	Year
1	Design of Machine Elements	V.B. Bhandari	Tata McGraw Hill	3rd Edition	2015
	Mechanical Engineering	Shigley J E and Mischke	McGraw Hill	5th Edition	2017
3	Mechanical design analysis	M F Spotts	Prentice Hall	5th Edition	2018
4	Data Books	PSG	Kalaikathie	2nd Edition	2016

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)
Proposed Scheme under Autonomy

BE (Mechanical Engineering)							**SEM:** VIII		
Course Name: Design of heat Exchanger							**Course Code:PEC- ME8012**		
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory (100)**		**Practical/Oral (25)**	**Term Work (25)**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR/OR**	**TW**	
4	-	2@	5	4	25	75	25	25	**150**

MSE: Mid Semester Examination - Paper Duration – **1.5 Hours**

SEE : End Semester Examination - Paper Duration - **3 Hours**

The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance (20%)

Prerequisite: Thermodynamics, Heat Transfer

Course Objective: course should be able to deliver fundamental knowledge about design of shell and Tube, Condenser, Double Pipe and Compact Heat Exchangers

Course Outcomes: Students will be able to:

SN	Course Outcomes	RBT Levels
1	Identify various types of heat exchanger	Understand(U)
2	Learn Basic design of heat exchanger	Apply(A)
3	Design of shell & Tube Heat Exchanger	Apply(A)
4	Design of Double Pipe Heat Exchange	Apply(A)
5	Design of Compact Heat Exchanger	Apply (A)
6	Design of Condenser and Evaporator	Apply(A)

Detailed Syllabus:

Module No.	Topics	Hrs.	RBT Levels
1	**Introduction** Constructional Details and Heat Transfer: Types - Shell and Tube Heat Exchangers - Regenerators and Recuperates - Industrial Applications, Temperature Distribution and its Implications - LMTD – Effectiveness, Selection of Heat Exchanger	5	L1,L2
2	**Basic Design Methods of Heat Exchanger** Introduction, Arrangement of flow path in Heat Exchanger, Basic Equations in Design, Overall Heat Transfer Coefficient, The LMTD Method, ε-NTU Method, Heat Exchanger Design Calculation, Heat Exchanger Design Methodology.	8	L2,L3
3	**Shell And Tube Heat Exchangers** Introduction, Basic Components, Basic Design Procedure of a Heat Exchanger, Shell-Side Heat Transfer and Pressure Drop.	8	L1,L2,L3
4	**Double Pipe Heat Exchangers** Introduction, Thermal & Hydraulic Design of Inner Tube, Thermal & Hydraulic Design of Annulus Tube, Parallel Series Arrangement of Hairpins, Design and Operational Features	8	L2,L3
5	**Compact Heat Exchangers** Introduction; definition of Geometric Terms: plate fin surface geometries and surface performance data; correlation of heat transfer and friction data; Goodness factor comparisons; specification of rating and sizing problems; calculation procedure for a rating problem.	8	L2,L3
6	**Condenser & Evaporator Design** Condensers and Evaporators Design: Design of Surface and Evaporative Condensers - Design of Shell and Tube - Plate Type Evaporators	8	L2,L3

Books and References:

SN	Title	Authors	Publisher	Edition	Year
1	Fundamentals of Heat Exchanger Design	Shah R K, Sekulic D P	John Wiley	9th Edition	2003
2	Heat exchangers : selection, rating and thermal design	KakacSadik, Liu Hongtan	CRC Press	2th Edition	2002
3	Heat Exchangers, Theory and Practice	T. Taborek, G.F. Hewitt and N.Afgan	McGraw Hill Book	-	1980
4	Industrial Heat Exchangers	Walker	McGraw Hill	-	1980
5	Heat Exchanger Design	Arthur P. Fraas	John Wiley & Sons	-	1988

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)
Proposed Scheme under Autonomy

B.E. (Mechanical Engineering)					**B.E. SEM:** VIII				
Course Name: Production and operations management					**Course Code:** PEC-ME8013				
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory (100)**		**Practical/Oral (20)**	**Term Work (20)**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR/ OR**	**TW**	
3	-	2	5	4	25	75	25	25	**150**
IA : In-Semester Assessment- Paper Duration-1 Hours									
ESE : End Semester Examination - Paper Duration - **3 Hours**									
The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance (20%)									
Prerequisite: Production Process II , Material Technology									

Course Objectives:

Course intend to provide an exposure to Production Planning & Control (PPC) and its significance in anufacturing Industries and to give insight into the ongoing & futuristic trends in the control of inventory. Also apply knowledge of production scheduling and sequencing so as to optimize resources

Course Outcomes:

SN	**Course Outcomes**	**Cognitive levels as per bloom's Taxonomy**
1	Illustrate production planning functions and manage manufacturing functions in a better way	L1, L2
2	Develop competency in scheduling and sequencing of manufacturing operations	L1, L2, L3, L4
3	Forecast the demand of the product and prepare an aggregate plan	L1, L2, L3, L4
4	Develop the skills of Inventory Management and cost effectiveness	L1, L2, L3, L4
5	Create a logical approach to Line Balancing in various production systems	L1, L2, L3, L4
6	Implement techniques of manufacturing planning and control	L1, L2, L3

Detailed Syllabus:

Module No.	Topics	Hrs.	Cognitive levels as per bloom's Taxonomy
	Concepts of PPC		
1	Introduction, Historical Development, Concept of Production, Production System, Classification of Production System , Job-Shop Production ,Batch Production Mass Production ,Continuous Production ,Production Management ,Objectives of Production Management ,Operations System, A Framework of Managing Operations , Operations Management, Operations Management Objectives The Strategic Role of Operations, Strategic Planning ,Scope of Operations Management	6	L1, L2, L3
2	**Operations Decision Making, System design and Capacity planning** Management as a Science, Characteristics of Decisions , Framework for Decision-Making , Decision Methodology, Complete Certainty Methods ,Risk and uncertainty Methods, Extreme Uncertainty Methods ,Decision-Making Under Uncertainty, Decision-Making Under Risk , Decision Support System, Economic Models, Break-even Analysis , Statistical Models, Equations for Discrete and Continuous Data , Decision Tree . **System design and Capacity** Introduction, Manufacturing and Service Systems Design and Systems Capacity, Capacity Planning, Process of Capacity Planning Importance of Capacity Decisions.	8	L1, L2, L3, L4
3	**Forecasting demand, Product development and design** **Forecasting demand :** Introduction , Forecasting Objectives and Uses Forecasting Decision Variables, Forecasting Methods ,Opinion and Judgmental Methods, Time Series Methods, Exponential Smoothing, Adjusted Exponential Smoothing Regression and Correlation Methods, Regression Correlation, Applications and Control of Forecast , Forecast Controls. **Product development and design:** Introduction, Purpose of a Product Design, Product Analysis, Marketing Aspect, The Product Characteristics, Economic Analysis, Production Aspect, A Framework for Process Design, Product Planning Process Design : MACRO, Process Design : MICRO, Design for Manufacture (DFM),Design for Excellence, Concurrent Development Activities.	8	L1, L2, L3, L4
4	**Materials Management, Aggregate planning and master scheduling** **Materials Management** Introduction and Meaning , Scope or Functions of Materials Management, Material Planning and Control, *Techniques of Material Planning,* Purchasing, *Objectives of Purchasing, Parameters of Purchasing ,Purchasing Procedure, Selection of Suppliers, Special Purchasing Systems,* Stores Management, *Codification,* Inventory Control or Management *Meaning of Inventory, Reasons for Keeping Inventories ,Meaning of Inventory Control, Objectives of Inventory Control ,Benefits of Inventory Control,* *Techniques of Inventory Control, Inventory Model,* Standardization *Advantages of Standardization,* **Aggregate planning and master scheduling :** Introduction ,Variables Used in	8	L1, L2, L3, L4

	Aggregate Planning , Aggregate Planning Strategies ,Mixed Strategies Mathematical Planning Models, Master Scheduling, *Master Scheduling Planning Horizon, Master Scheduling Format, Available-to-Promise Quantitie.*		
5	**Material requirement planning, scheduling** **Material requirement planning,** MRP and CRP Objectives, MRP Inputs and Outputs, *Bill of Materials* , *Low-level Coding* ,MRP , Enterprise Resource Planning **Scheduling:** Introduction, Concept of Single Machine Scheduling , Measures of Performance, Shortest Processing Time (SPT) Rule, WSPT Rule ,Earliest Due Date (EDD) Rule, Minimizing the Number of Tardy Jobs, Flow Shop Scheduling Johnson's Problem ,*Johnson's Algorithm ,Extension of Johnson's Rule* ,CDS Heuristic Job-Shop Problem, Types of Schedules, Heuristic Procedures, Priority Dispatching Rules, Two Jobs and M Machines Scheduling.	10	L1, L2, L3, L4
	JIT and Lean Production		
6	Aim, Objectives, Learning outcome, Introduction, History and Philosophy of Just-In-Time (JIT),Just-In-Time Concept Benefits and Problems Implementation of JIT Lean Manufacturing Lean Production Overview Basic Elements of Lean Manufacturing Characteristics of a Lean Manufacturing Key Feature of Lean Production Benefits of Lean Production, Five Elements to Enabling Approach, Tips to Transition Company into Lean Enterprise, Six-Sigma, Objectives of Six-Sigma, Integrating Six Sigma with Business Process Management, Six Main Benefits of the Sigma Breakthrough Strategy, Difference between TQM and Six Sigma, Critical Success Factors of an Organization for Successful TPS-Lean, Six Sigma Implementation	8	L1, L2, L3, L4

Books and References:

SN	Title	Authors	Publisher
1	Production Planning and Control	Samuel Eilon.	-
2	Operations management	S.Anil Kumar and N Suresh	New Age international
3	Production Planning and Control	W. Boltan-	Longman Scientific & Technical
4	Production Systems- Planning, Analysis& Control	James. L. Riggs-John Wiley &Sons	-

5	Manufacturing Planning and Control Systems	Thomas E. Vollman, WilliamL.Berry& Others	Galgotia Publishers
6	Manufacturing Process Planning and Systems Engineering	AnandBewoor	Dreamtech Press
7	Production and Operations Management	S.N.Chary	TMH publishing company
8.	Modernization & Manufacturing Management	L.C. Jhamb	Everest PublishingHouse

Online References:

S. No.	Website Name	U RL	Modules Covered
1	www.nptel.ac.in	https://nptel.ac.in/courses/112107238/26	M1-M6

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)
Proposed Scheme under Autonomy

B.E. (Mechanical Engineering)					**B.E. SEM:** VIII				
Course Name: Production and operations management					**Course Code:** PEC-ME8013				
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory (100)**		**Practical/Oral (20)**	**Term Work (20)**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR/ OR**	**TW**	
3	-	2@	5	4	25	75	25	25	**150**
IA : In-Semester Assessment- Paper Duration-1 Hours									
ESE : End Semester Examination - Paper Duration - **3 Hours**									
The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance (20%)									
Prerequisite: Production Process II , Material Technology									

Course Objectives:

Course intend to provide an exposure to Production Planning & Control (PPC) and its significance in Manufacturing Industries and to give insight into the ongoing & futuristic trends in the control of inventory. Also apply knowledge of production scheduling and sequencing so as to optimize resources

Course Outcomes:

SN	**Course Outcomes**	**Cognitive levels as per bloom's Taxonomy**
1	Illustrate production planning functions and manage manufacturing functions in a better way	L1, L2
2	Develop competency in scheduling and sequencing of manufacturing operations	L1, L2, L3, L4
3	Forecast the demand of the product and prepare an aggregate plan	L1, L2, L3, L4
4	Develop the skills of Inventory Management and cost effectiveness	L1, L2, L3, L4
5	Create a logical approach to Line Balancing in various production systems	L1, L2, L3, L4
6	Implement techniques of manufacturing planning and control	L1, L2, L3

Detailed Syllabus:

Module No.	Topics	Hrs.	Cognitive levels as per bloom's Taxonomy
	Concepts of PPC		
1	Introduction, Historical Development, Concept of Production, Production System, Classification of Production System , Job-Shop Production ,Batch Production Mass Production ,Continuous Production ,Production Management ,Objectives of Production Management ,Operations System, A Framework of Managing Operations , Operations Management, Operations Management Objectives The Strategic Role of Operations, Strategic Planning ,Scope of Operations Management	6	L1, L2, L3
2	**Operations Decision Making, System design and Capacity planning** Management as a Science, Characteristics of Decisions , Framework for Decision-Making , Decision Methodology, Complete Certainty Methods ,Risk and uncertainty Methods, Extreme Uncertainty Methods ,Decision-Making Under Uncertainty, Decision-Making Under Risk , Decision Support System, Economic Models, Break-even Analysis , Statistical Models, Equations for Discrete and Continuous Data , Decision Tree . **System design and Capacity** Introduction, Manufacturing and Service Systems Design and Systems Capacity, Capacity Planning, Process of Capacity Planning Importance of Capacity Decisions.	8	L1, L2, L3, L4
3	**Forecasting demand, Product development and design** **Forecasting demand :** Introduction , Forecasting Objectives and Uses Forecasting Decision Variables, Forecasting Methods ,Opinion and Judgmental Methods, Time Series Methods, Exponential Smoothing, Adjusted Exponential Smoothing Regression and Correlation Methods, Regression Correlation, Applications and Control of Forecast , Forecast Controls. **Product development and design:** Introduction, Purpose of a Product Design, Product Analysis, Marketing Aspect, The Product Characteristics, Economic Analysis, Production Aspect, A Framework for Process Design, Product Planning Process Design : MACRO, Process Design : MICRO, Design for Manufacture (DFM),Design for Excellence, Concurrent Development Activities.	8	L1, L2, L3, L4
4	**Materials Management, Aggregate planning and master scheduling** **Materials Management** Introduction and Meaning , Scope or Functions of Materials Management, Material Planning and Control, *Techniques of Material Planning,* Purchasing, *Objectives of Purchasing, Parameters of Purchasing ,Purchasing Procedure, Selection of Suppliers, Special Purchasing Systems,* Stores Management, *Codification,* Inventory Control or Management *Meaning of Inventory, Reasons for Keeping Inventories ,Meaning of Inventory Control, Objectives of Inventory Control ,Benefits of Inventory Control,* *Techniques of Inventory Control, Inventory Model,* Standardization *Advantages of Standardization,* **Aggregate planning and master scheduling :** Introduction ,Variables Used in	8	L1, L2, L3, L4

	Aggregate Planning , Aggregate Planning Strategies ,Mixed Strategies Mathematical Planning Models, Master Scheduling, *Master Scheduling Planning Horizon, Master Scheduling Format, Available-to-Promise Quantitie.*		
5	**Material requirement planning, scheduling** **Material requirement planning,** MRP and CRP Objectives, MRP Inputs and Outputs, *Bill of Materials* , *Low-level Coding* ,MRP , Enterprise Resource Planning **Scheduling:** Introduction, Concept of Single Machine Scheduling , Measures of Performance, Shortest Processing Time (SPT) Rule, WSPT Rule ,Earliest Due Date (EDD) Rule, Minimizing the Number of Tardy Jobs, Flow Shop Scheduling Johnson's Problem ,*Johnson's Algorithm ,Extension of Johnson's Rule ,*CDS Heuristic Job-Shop Problem, Types of Schedules, Heuristic Procedures, Priority Dispatching Rules, Two Jobs and M Machines Scheduling.	10	L1, L2, L3, L4
	JIT and Lean Production		
6	Aim, Objectives, Learning outcome, Introduction, History and Philosophy of Just-In-Time (JIT),Just-In-Time Concept Benefits and Problems Implementation of JIT Lean Manufacturing Lean Production Overview Basic Elements of Lean Manufacturing Characteristics of a Lean Manufacturing Key Feature of Lean Production Benefits of Lean Production, Five Elements to Enabling Approach, Tips to Transition Company into Lean Enterprise, Six-Sigma, Objectives of Six-Sigma, Integrating Six Sigma with Business Process Management, Six Main Benefits of the Sigma Breakthrough Strategy, Difference between TQM and Six Sigma, Critical Success Factors of an Organization for Successful TPS-Lean, Six Sigma Implementation	8	L1, L2, L3, L4

Books and References:

SN	Title	Authors	Publisher
1	Production Planning and Control	Samuel Eilon.	-
2	Operations management	S.Anil Kumar and N Suresh	New Age international
3	Production Planning and Control	W. Boltan-	Longman Scientific & Technical
4	Production Systems- Planning, Analysis& Control	James. L. Riggs-John Wiley &Sons	-

5	Manufacturing Planning and Control Systems	Thomas E. Vollman, WilliamL.Berry& Others	Galgotia Publishers
6	Manufacturing Process Planning and Systems Engineering	AnandBewoor	Dreamtech Press
7	Production and Operations Management	S.N.Chary	TMH publishing company
8.	Modernization & Manufacturing Management	L.C. Jhamb	Everest PublishingHouse

Online References:

S. No.	Website Name	U RL	Modules Covered
1	www.nptel.ac.in	https://nptel.ac.in/courses/112107238/26	M1-M6

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019) TCET Autonomy Scheme (w.e.f. A.Y. 2019-20)

B.E. (Mechanical Engineering)							**B.E. SEM:** VIII		
Course Name: Renewable Energy Sources							**Course Code: PEC-ME8014**		
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory (100)**		**ctical/Oral (20)**	**rm Work (20)**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR/ OR**	**TW**	
3	-	2@	5	4	25	75	25	25	**150**

IA:In-Semester Assessment- Paper Duration-1 Hours

ESE : End Semester Examination - Paper Duration - **3 Hours**

narks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance (20%)

Prerequisite: Thermodynamics

Course Objectives:

Course intend to provide working principles of various renewable energy sources and their utilities

Course Outcomes:

SN	Course Outcomes	Cognitive levels as per bloom's Taxonomy
1	Demonstrate need of different renewable energy sources	L1, L2
2	Discuss importance of renewable energy sources	L1
3	Discuss various renewable energy sourses in Indian context	L1, L2, L3, L4
4	Calculate and analyse utilization of solar and wind energy	L1, L2, L3, L4
5	Illustrate design of biogas plant	L1, L2, L3, L4
6.	Demonstrate basics of hydrogen energy	L1, L2

Detailed Syllabus:

Module No.	Topics	Hrs.	Cognitive levels as per bloom's Taxonomy
1	**Introduction to Energy Sources** Renewable and non-renewable energy sources, Need for Renewable Energy Sources, Energy Consumption as a measure of Nation's development; Strategy for meeting the future energy requirements, Global and National scenarios, Prospects of renewable energy sources, Present status and current installations, Introduction to Hybrid EnergySystems.	7	L1, L2
2	**Solar energy** Merits and demerits, Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length, Methods of Solar Radiation estimation. **Solar Energy collection devices and Classification:** Flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, Solar Photovoltaic systems & applications.	12	L1
3	**Wind Energy** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of Aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.	10	1, L2, L3, L4
4	**Energy from biomass** Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas.	6	1, L2, L3, L4
5	**Geothermal Energy** Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India. **Energy from the ocean**: Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy	8	1, L2, L3, L4
6	**Hydrogen Energy** Methods of Hydrogen production, Hydrogen Storage, Fuel Cells and Types of Fuel Cells.	5	L1, L2

Books and References:

SN	Title	Authors	Publisher	Edition	Year
1	Non-conventional energy sources	G.D. Rai	Khanna Publishers	1st Edition	2004
2	Renewable Energy:Power for a Sustainable Future	Edited by Godfrey Boyle	Oxford University Press	3rd Edition	2006
3	Solar Energy: Principles of Thermal Collection and Storage	SP Sukhatme and J K Nayak	TMH	2nd Edition	2004
4	Wind and Solar Power Systems	Mukund R Patel	CRC Press ,	1st Edition	2006

Online References:

S. No.	Website Name	URL	Modules Covered
1	www.nptel.ac.in	https://nptel.ac.in	M1-M6

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)
TCET Autonomy Scheme (w.e.f. A.Y. 2020-21)

<table>
<tr><td colspan="8">B.E. Course</td><td colspan="4">B.E. Open Elective SEM : VIII</td></tr>
<tr><td colspan="8">Course Name: Project Management</td><td colspan="4">Course Code : OEC- 8011</td></tr>
<tr><td colspan="8">Teaching Scheme (Program Specific)</td><td colspan="4">Examination Scheme (Formative/ Summative)</td></tr>
<tr><td colspan="8">Modes of Teaching / Learning / Weightage</td><td colspan="4">Modes of Continuous Assessment / Evaluation</td></tr>
<tr><td colspan="8" rowspan="2">Hours Per Week</td><td colspan="2">Theory (100)</td><td>Practical/Oral (25)</td><td>Term Work (25)</td><td>Total</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>Contact Hours</td><td>Credits</td><td>IA</td><td>ESE</td><td>PR/OR</td><td>TW</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>25</td><td>75</td><td>-</td><td>-</td></tr>
<tr><td colspan="12">IA: In-Semester Assessment - Paper Duration – 1 Hours
ESE: End Semester Examination - Paper Duration - 3 Hours
The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance / Learning Attitude (20%)</td></tr>
<tr><td colspan="12">Prerequisite: Data Structure, Software Engineering</td></tr>
</table>

Course Objective: The objective of the course is to familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques and appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Course Outcomes: Upon completion of the course students will be able to:

Sr No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	Apply selection criteria and select an appropriate project from different options	L1, L2, L3, L4
2	Write work break down structure for a project and develop a schedule based on it	L1, L2, L3, L4
3	Identify opportunities and threats to the project and decide an approach to deal with them strategically.	L1, L2, L3, L4
4	Use Earned value technique and determine & predict status of the project.	L1, L2, L3, L4
5	Compare and contrast various project execution, Monitoring and Controlling Projects, Project Contracting, Project Leadership and Ethics and Closing the Project	L1, L2, L3, L4
6	Capture lessons learned during project phases and document them for future reference	L1, L2

Detailed Syllabus:

Module No.	Topics	Hrs.	Cognitive levels of attainment as per Bloom's Taxonomy
1	**Project Management Foundation** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI).	6	L1, L2, L3, L4
2	**Initiating Projects** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &performing), team dynamics	6	L1, L2, L3, L4
3	**Project Planning and Scheduling** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8	L1, L2, L3, L4
4	**Planning Projects** Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	8	L1, L2, L3, L4
5	**Executing Projects, Monitoring and Controlling Projects & Project Contracting** 5.1 Executing Projects: Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings 5.2 Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit. 5.3 Project Contracting : Project procurement management, contracting and outsourcing,	10	L1, L2, L3, L4
6	**Project Leadership and Ethics & Closing the Project** 6.1 Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Multicultural and virtual projects 6.2 Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	7	L1, L2
	Total Hours	**45**	

Books and References:

S.No	Title	Authors	Publisher	Edition	Year
1	Project Management Foundation:	Project Management: A managerial approach, Jack Meredith & Samuel Mantel.	Wiley India	Seventh Edition	2009
2	Initiating Projects & Project Planning and Scheduling	A Guide to the Project Management Body of Knowledge (PMBOK® Guide)	Project Management Institute PA, USA	Fifth Edition	--
3	Planning Projects	Project Management, Gido Clements	Cengage Learning	--	--
4	Executing Projects, Monitoring and Controlling Projects & Project Contracting	Project Management, Gopalan Wiley India	Wiley India	--	--
5	Project Leadership and Ethics & Closing the Project	Project Management, Dennis Lock.	Gower Publishing England	Ninth Edition	--

Online Resources:

S. No.	Website Name	URL	Modules Covered
1	http://www.opentextbooks.org.hk	http://www.opentextbooks.org.hk/system/files/export/15/15694/pdf/Project_Management_15694.pdf	M1-M6
2	https://www.nesacenter.org	https://www.nesacenter.org/uploaded/conferences/SEC/2014/handouts/Rick_Detwiler/15_Detwiler_Resources.pdf	M1-M3, M6
3	http://www.edo.ca	http://www.edo.ca/downloads/project-management.pdf	M1,M4

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)
TCET Autonomy Scheme (w.e.f. A.Y. 2020-21)

<table>
<tr><td colspan="5">B.E. Course</td><td colspan="4">BE Open Elective (SEM: VIII)</td></tr>
<tr><td colspan="5">Course Name: Energy Audit and Management</td><td colspan="4">Course Code: OEC- 8012</td></tr>
<tr><td colspan="5">Teaching Scheme (Program Specific)</td><td colspan="4">Examination Scheme (Formative/ Summative)</td></tr>
<tr><td colspan="5">Modes of Teaching / Learning / Weightage</td><td colspan="4">Modes of Continuous Assessment / Evaluation</td></tr>
<tr><td colspan="5">Hours Per Week</td><td>Theory (100)</td><td>Practical/Oral (25)</td><td>Term Work (25)</td><td>Total</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>Contact Hours</td><td>Credits</td><td>IA</td><td>ESE</td><td>PR</td><td>TW</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>25</td><td>75</td><td>-</td><td>-</td></tr>
<tr><td colspan="9">IA: In-Semester Assessment - Paper Duration – 1.5 Hours
ESE: End Semester Examination - Paper Duration - 3 Hours
The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance / Learning Attitude (20%)</td></tr>
<tr><td colspan="9">Prerequisite: - Knowledge of Basic Electrical and Mechanical Systems</td></tr>
</table>

Course objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course outcomes: After successful completion of the course student will be able:-

SN	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	To identify and describe present state of energy security and its importance.	L1
2	To identify and describe the basic principles and methodologies adopted in energy audit of any utility.	L1, L2, L3
3	To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.	L1, L2, L3, L4
4	To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities	L1, L2, L3, L4
5	To analyze the data collected during performance evaluation and recommend energy saving measures	L1, L2, L3
6	To understand the concept of Energy conservation measures in building complex	L1

Detailed Syllabus

Module No.	Unit No.	Topics	Hrs	Cognitive levels of attainment as per Bloom's Taxonomy
1	**Energy Scenario & Energy Conservation measures**		04	L1
	1.1	Present Energy Scenario		
	1.2	Renewable and Non-Renewable form of Energy		
	1.3	Greenhouse Gas effect, Acid Rain, Energy Pricing, Energy Sector Reforms,		
	1.4	Energy Conservation and its Importance: Energy Conservation Act-2001 and its features. Role of Bureau of Energy Efficiency (BEE), Energy Security, Basic idea of Material and Energy balance		
2	**Energy Audit & Energy Economics**		08	L1, L2, L3
	2.1	Energy Audit: Definition, need, types of energy audit, Steps of detailed Energy Audit, Role of Energy Manager and Internal audit Team,		
	2.2	Measuring instruments & Equipment used during Energy audit		
	2.3	Understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement,		
	2.4	Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution		
	2.5	Elements of monitoring & targeting, Data and information analysis.		
	2.6	Energy Economics: Simple payback period (SPP), Net Present value (NPV), Return on investment (ROI), Internal rate of return (IRR)		
3	**Energy Management in Electrical System**		10	L1, L2, L3, L4
	3.1	Electricity billing, Basic concept of Electrical load management, Maximum demand Control, Energy management through Power factor improvement		
	3.2	Energy efficient equipment and appliances, Star ratings of Electrical Equipment.		
	3.3	Lighting System control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy efficiency measures in lighting system		
	3.4	Energy conservation opportunities in water pumps, industrial drives, induction motors, soft starters, variable speed drives.		
4	**Energy Management in Thermal Systems**		10	L1. L2, L3,L4
	4.1	Review of different thermal loads, Steam System: Basic idea of Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Energy conservation in Steam distribution system,		
	4.2	Boiler System: General fuel conservation measures in Boilers and furnaces, Waste heat recovery, cogeneration, use of insulation- types and application.		

	4.3	HVAC system: Coefficient of performance, Capacity, factors affecting performance of Refrigeration and Air Conditioning system performance, Energy savings opportunities in HVAC system.		
5	**Energy Performance Assessment**		**04**	**L1, L2, L3,**
	5.1	Performance assessment of Motors, variable speed drive, pumps,		
	5.2	Lighting System calculations: Installed Load Efficacy Ratio (ILER) method,		
	5.3	HVAC system calculations; various terms used in assessment of performance		
6	**Energy conservation in Residential and Commercial Buildings**		**03**	**L1**
	6.1	Energy Conservation Building Codes (ECBC)		
	6.2	Green Building norms, LEED ratings of buildings, Use of renewable energy sources in building complex		
		Total	**39**	

Books of Reference

SN	Title	Authors	Publisher
1.	Handbook of Electrical Installation Practice	Geofry Stokes	Blackwell Science
2.	Designing with light: Lighting System Handbook	By Anil Valia	-
3.	Energy Management handbook	W.C. Turner	John Wiley and Sons
4.	Handbook on Energy Audits and Management	A. K. Tyagi,	Tata Energy Research Institute (TERI).
5.	Energy Management Principles	C.B. Smith	Pergamon Press
6.	Energy Conservation Guidebook	Dale R. Patrick, S. Fardo, Ray E. Richardson	Fairmont Press
7.	Handbook of Energy Audits	Albert Thumann, W. J. Younger, T. Niehus	CRC Press

Online Reference

SNo.	Website Name	URL	Modules Covered
1	Bureau of Energy Efficiency	https://beeindia.gov.in/content/energy-auditors	1-2
2	You tube	https://youtube/7hDyLuFJ0c8	1-6
3	You tube	https://www.youtube.com/watch?v=UhGZRoUlr8U	1-6
4	NPTEL by IIT Roorkee	https://www.youtube.com/watch?v=2zWt-pBCU2I	1-3

B.E. Semester –VIII

Choice Based Credit Grading Scheme with Holistic Multidisciplinary Education -(CBCGS-H 2020) TCET Autonomy Scheme (w.e.f. A.Y. 2020-21)

<table>
<tr><td colspan="5">B. E. Course</td><td colspan="6">B.E. Open Elective SEM VIII</td></tr>
<tr><td colspan="5">Course Name : Innovation Management</td><td colspan="6">Course Code : OEC- 8013</td></tr>
<tr><td colspan="5">Contact Hours Per Week : 3</td><td colspan="6">Credits : 3</td></tr>
<tr><td colspan="5">Teaching Scheme (Program Specific)</td><td colspan="6">Examination Scheme (Formative/ Summative)</td></tr>
<tr><td colspan="5">Modes of Teaching / Learning / Weightage</td><td colspan="6">Modes of Continuous Assessment / Evaluation</td></tr>
<tr><td colspan="5">Hours Per Week</td><td colspan="2">Theory (100)</td><td colspan="2">Practical/Oral/Presentation (25)</td><td colspan="2">Term Work (25)</td><td>Total</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>Contact Hours</td><td>Credits</td><td>IA</td><td>ESE</td><td>MSA</td><td>ESE</td><td>MSA</td><td>ESE</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>25</td><td>75</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="12">MSA: Mid Semester Assessment- Paper Duration – 1 hr
ESE: End Semester Evaluation-Paper Duration-3 hrs.
Mid Semester Assessment for Term work will be on continues basis</td></tr>
<tr><td colspan="12">Prerequisite: Financial Accounting and Management and Business Modelling.
RBT : Revised Bloom’s Taxonomy</td></tr>
</table>

Course Objective: The course intends to apply the concept of Innovation in Business.

Course Outcomes: Upon completion of the course students will be able to:

L1: Remembering **L2:** Understanding **L3:** Applying **L4:** Analysing **L5:** Evaluating **L6:** Creating

Sr. No.	Course Outcomes	RBT level
1	Able to analyze and apply impact of innovation on society	L1,L2,L4
2	Able to understand the role of technology in creating wealth	L1,L2,L3
3	Recognize markers of business models which appear as a response to digital revolution	L1,L2,L3,L4
4	Search for real cases which represent new business models	L1,L2,L3,L4

5	Identify similar and distinguished features of business build on identical business models	L1,L2,L3,L4
6	Know the most important cases of data-driven business founded on new business models	L2,L4

Detailed Syllabus:

Module No.	Topics	Hrs.	RBT Levels
01	**Sources of Innovation** **Sources of Innovation:** Innovation / wealth creation process, three critical trajectories impacting the innovation process creative transformations, the importance of technological Innovation, The impact of technological innovation on society. Case study on impact of technological innovation on society. Industry dynamics of technological innovation, transcending creativity into innovation, innovation as a collaborative effort.	**08**	L1,L2,L4
02	**Types and patterns of innovation** **Types and patterns of innovation**: Technology S curves, formulation of technological innovation strategy, implementing technological innovation strategies. Managing new product development. Case study on new product development.	**06**	L1,L2,L3
03	**Collaboration strategies and Choosing innovative projects** **Collaboration Strategies:** The role of technology in the creation of wealth, historical perspective, long-wave cycle, evolution of production technology, technology and national economy. Case study on Collaboration Strategies. **Choosing innovative projects:** Management of technology, the conceptual frame work, technology and society, knowledge and technology, technology and business. Case study on How to choose innovative projects.	**08**	L1,L2,L3,L4
04	**Introduction to Business Models** What is a Business Model? Importance of Business Model. History of Business Model. Type of Business Model	8	L1,L2,L3,L4
05	**Business models as a key concept of strategic management.** Variety of business model frameworks: Canvas, 'Zott-Amit' model, BM navigator, 4W approach, Hybrid business models. Resource-based view (RBV). Industrial organization.	8	L1,L2,L3,L4
06	**Digital business models.**	8	L2,,L4,

	E-commerce. Innovative business model in retail and consumer goods. Omnichannel retail. Manufacturing business models. Digital manufacturing. Developers as new decision makers. Case-study of Apple, Android, Tinkoff.		
	Total	**46**	

Books and References:

Sr. No	Title of the book	Authors	Publisher	Edition	Year
1	Strategic management of technological Innovation	Melissa A. Schilling	McGraw-Hill	Fifth Edition	2017
2	Management of technology	Tarek M. Khalil	McGraw Hill	Second Edition	2009
3	Business model generation: a handbook for visionaries, game changers, and challengers.	Osterwalder, A., &Pigneur, Y.	John Wiley & Sons	ThirdEdition	2010
4	Value creation in e-business.	Amit, R., &Zott, C.	Strategic management journal,	22(6-7), 493-520.	2001

Online Reference

SNo.	Website Name	URL	Modules Covered
1.	Ideaconnection.com	https://www.ideaconnection.com/innovation-videos/	M1,M2
2.	Ideaconnection.com	https://www.ideaconnection.com/innovation-videos/	M3,M4
3.	Ideaconnection.com	https://www.ideaconnection.com/innovation-videos/	M5,M6
4.	https://nptel.ac.in	https://nptel.ac.in/courses/110/107/110107094/	M1,M2,M3,M4,M5,M6
5.	Coursera.org	https://www.coursera.org/learn/digital-business-models/lecture/nJTB0/lesson-4-asymmetric-business-models-creating-unfair-advantage	M4,M5,M6
6.	online.stanford.edu	https://online.stanford.edu/courses/xine249-building-business-models	M1,M2,M3,M4,M5,M6

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)
Proposed Syllabus under Autonomy Scheme (w.e.f. A.Y. 2020-21)

B.E. Course									**BE Open Elective SEM:** VIII
Course Name : Environmental Management									**Course Code:** OEC- 8014
Contact Hours Per Week : 03									**Credits** : 03
Teaching Scheme (Program Specific)					**Examination Scheme (Formative/ Summative)**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory (100)**	**Practical/Oral (25)**	**Term Work (25)**		**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR**	**TW**	**100**
3	_	_	3	3	20	80	–	_	
IA: Internal Assessment - Paper Duration – 1 Hour **ESE: End Semester Examination - Paper Duration - 3 Hours** **The weightage of marks for continuous evaluation of Term work/Report:** Formative (40%), Timely completion of practical (40%) and Attendance/Learning Attitude (20%)									
Prerequisite: Fundamentals of Chemistry and biology									

Course Objective: The course intends to give an understanding of environmental issues relevant to India and global concerns, the concept of ecology and familiarize the learner with environment related legislations.

Course Outcomes: Upon completion of the course student will be able to:

S. No	**Course Outcomes**	**Cognitive levels of attainment as per Bloom's Taxonomy**
1	Understand the concept of environmental management and the Energy scenario.	L1 L2
2	Understand ecosystem and interdependence, food chain etc.	L1 L2
3	Understand and interpret environment related legislations	L1 L2 L3 L4

Detailed Syllabus:

Module No.	**Topics**	**Hrs .**	**Cognitive levels of Attainment as per Bloom's Taxonomy**
1	**Introduction and Definition of Environment** Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario.	5	L1 L2

2	**Global Environmental concerns** Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	6	L1 L2
3	**Concepts of Ecology** Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	7	L1 L2
4	**Scope of Environment Management** Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility.	7	L1 L2 L3 L4
5	**Total Quality Environmental Management** ISO-14000, EMS certification.	7	L1 L2 L3 L4
6	**General overview of major legislations** Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	7	L1 L2 L3
	Total	39	

Books and References:

Sr.No.	Title	Author	Publisher	Edition	Year
1	Environmental Management: Principles and Practice	C J Barrow	Routledge Publishers	1st	1999
2	A Handbook of Environmental Management	John C. Lovett and David G. Ockwell	Edward Elgar Publishing	----------	2010
3	Environmental Management	V Ramachandra and Vijay Kulkarni	TERI Press	1st	2006
4	Indian Standard Environmental Management Systems — Requirements With Guidance For Use	Bureau Of Indian Standards	----------	----------	2005
5	Environmental Management: An Indian Perspective	S N Chary and Vinod Vyasulu	Macmillan India	----------	2000
6	Introduction to Environmental Management	Mary K Theodore and Louise Theodore	CRC Press	----------	2009
7	Environment and Ecology	Majid Hussain	Access Publishing	3rd	2015

Online References:

Sr. No.	Website Name	URL
1	Alison	https://alison.com/course/introduction-to-ecology
2	ISO	https://www.iso.org/iso-14001-environmental-management.html
3	Certified Environment Law Analyst	https://www.vskills.in/certification/legal/environment-law-certification

B.E. Semester –VIII
Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)
Proposed Syllabus under Autonomy Scheme (w.e.f. A.Y. 2020-21)

B.E. Course							**B.E. Open Elective SEM: VIII**		
Course Name: IPR and Patenting							**Course Code:** OEC- 8015		
Teaching Scheme (Program Specific)					**Examination scheme**				
Modes of Teaching / Learning / Weightage					**Modes of Continuous Assessment / Evaluation**				
Hours Per Week					**Theory (100)**		**Practical/Oral (25)**	**Term Work (25)**	**Total**
Theory	**Tutorial**	**Practical**	**Contact Hours**	**Credits**	**IA**	**ESE**	**PR**	**TW**	**100**
3	-	-	3	3	25	75	-	-	
IA: Internal Assessment - Paper Duration – **1.5 Hours** **ESE:** End Semester Examination - Paper Duration - **3 Hours** **The weightage of marks for continuous evaluation of Term work/Report:** Formative (40%), Timely completion of practical (40%) and Attendance (20%)									

Course Objective:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Course Outcome

SN	**Course Outcomes**	**Cognitive Levels as per Blooms Taxonomy**
1	understand Intellectual Property assets	L1,L2
2	assist individuals and organizations in capacity building	L1,L2,L3
3	work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting	L1,L2,L3

Detailed Syllabus :

Module No.	**Topics**	**Hrs**	**Cognitive Levels as per Blooms Taxonomy**
1	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	5	L1,L2
2	**Enforcement of Intellectual Property Rights:**	7	

	Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.		L1,L2,L3
3	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	5	L1,L2,L3
4	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc),Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	7	L1,L2,L3
5	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	8	L1,L2
6	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	7	L1,L2,L3

Books and References:

S. No.	Title	Authors	Publisher	Edition	Year
1	Patent system and related issues at a glance	Keayla B K	National Working Group	First	2004
2	The enforcement of Intellactual Property Rights	Lous Harns	Wipo	3rd	2018

BE SEMESTER VIII

Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)

Proposed Syllabus under Autonomy Scheme (w.e.f. A.Y. 2020-21)

<table>
<tr><td colspan="6">B.E. Course</td><td colspan="4">B.E. Open Elective SEM: VIII</td></tr>
<tr><td colspan="6">Course Name: Supply Change Management</td><td colspan="4">Course Code: OEC 8016</td></tr>
<tr><td colspan="5">Teaching Scheme (Program Specific)</td><td colspan="5">Examination Scheme (Formative/ Summative)</td></tr>
<tr><td colspan="5">Modes of Teaching / Learning / Weightage</td><td colspan="5">Modes of Continuous Assessment / Evaluation</td></tr>
<tr><td colspan="5">Hours Per Week</td><td colspan="2">Theory (100)</td><td>Practical/Oral (20)</td><td>Term Work (20)</td><td>Total</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>Contact Hours</td><td>Credits</td><td>IA</td><td>ESE</td><td>PR/ OR</td><td>TW</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>25</td><td>75</td><td>-</td><td>-</td></tr>
<tr><td colspan="10">IA: In-Semester Assessment- Paper Duration-1 Hours
ESE : End Semester Examination - Paper Duration - 3 Hours
The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance (20%)</td></tr>
<tr><td colspan="10">Prerequisite: NILL</td></tr>
</table>

Course Objective:

1. To acquaint with key drivers of supply chain performance and their inter-relationships with strategy.
2. To impart analytical and problem-solving skills necessary to develop solutions for a variety of supply chain management & design problems.
3. To study the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories, and strategic alliances.

Course Outcome:

SN	Course Outcomes	Cognitive Levels as per Bloom's Taxonomy
1	To acquaint with key drivers of supply chain performance and their inter-relationships with strategy.	L1,L2,L3
2	To impart analytical and problem-solving skills necessary to develop solutions for a variety of supply chain management & design problems.	L1,L3,L4
3	To study the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.	L1,L2,L4

Module	Detailed Contents	Hours	Cognitive Levels as per Bloom's Taxonomy
01	**Building a Strategic Framework to Analyze Supply Chains** Supply chain stages and decision phases, Process view of supply	04	L1,L2,L3

	chain: Supply chain flows, Examples of supply chains, Competitive and supply chain strategies, Achieving strategic fit: Expanding strategic scope, Drivers of supply chain performance. Framework for structuring drivers: inventory, transportation facilities, information obstacles to achieving fit.		
02	**Designing the Supply Chain Network** Distribution Networking: Role, Design, Supply Chain Network(SCN):Role, Factors, Framework for design decisions.	05	L1,L3,L4
03	**Materials Management** Scope, Importance, Classification of materials, Procurement, Purchasing policies, Vendor development and evaluation. Inventory control systems of stock replenishment, Cost elements, EOQ and its derivative modules.	06	L1,L2,L3
04	**Dimensions of Logistics** Introduction: A Macro and Micro Dimensions, Logistics interfaces with other areas, Approach to analyzing logistics system, Logistics and systems analyzing: Techniques of logistics system analysis, factors affecting the cost and Importance of logistics.	06	L1,L3,L4
05	**Warehouse and Transport Management** Concept of strategic storage, Warehouse functionality, Warehouse operating principles, Developing warehouse resources, Material handling and packaging in warehouses, Transportation Management, Transport functionality and principles, Transport infrastructure, transport economics and Pricing. Transport decision making.	07	L1,L2,L3
06	**IT in Supply Chain** 6.1 IT framework, Customer Relationship Management (CRM),internal Supply chain management, Supplier Relationship Management (SRM) and Transaction Management. Coordination in a Supply Chain 6.2 Lack of supply chain coordination and the Bullwhip effect, Obstacle to Coordination, Managerial levers, Building partnerships and trust. Emerging Trends and Issues 6.3 Vendor managed inventory-3PL-4PL, Reverse logistics: Reasons, Role, Activities; RFID systems: Components, Applications, Implementation; Lean supply chain, Implementation of Six Sigma in supply chain, Green supply chain.	08	L1,L3,L4

Books and References:

SN	Title	Authors	Publisher	Edition	Year
1	*Supply Chain Management Strategy, Planning, and operations*	Sunil Chopra and Peter Meindl	Pearson	6th Edition	2016
2	*Designing & Managing Supply chain*	David Simchi Levi, Philip Kaminsky& Edith Smichi	McGraw Hill	3rd Edition	2007

		Levi			
3	*Supply Chain Redesign: Transforming Supply Chains into Integrated Value Systems*,	Robert B Handfield, Ernest L Nicholas	Prentice Hall	--	2002
4	*The Management of Business Logistics: A Supply Chain Perspective*	Coyle, Bardi, Langley	Thomson learning	--	2003
5	Supply chain management: for global competitiveness	B S Sahay	Macmillan	--	1999

Online Resources:

S. No.	Website Name	URL	Modules covered
1.	https://nptel.ac.in	https://nptel.ac.in/courses/110/106/110106045/	2
2.	? https://nptel.ac.in	https://nptel.ac.in/courses/110/107/110107074/	3
3.	https://www.scmhub.com	https://www.scmhub.com/courses/BBA	2
4.	https://www.udemy.com	https://www.udemy.com/topic/supply-chain/	4

BE SEMESTER VIII

Choice Based Credit Grading Scheme with Holistic Student Development (CBCGS- H 2019)

Proposed Syllabus under Autonomy Scheme (w.e.f. A.Y. 2020-21)

<table>
<tr><td colspan="8">B.E. (Mechanical Engineering)</td><td colspan="4">B.E. SEM: VIII</td></tr>
<tr><td colspan="8">Course Name: Product Design and Development</td><td colspan="4">Course Code: OEC 8025</td></tr>
<tr><td colspan="8">Teaching Scheme (Program Specific)</td><td colspan="4">Examination Scheme (Formative/ Summative)</td></tr>
<tr><td colspan="8">Modes of Teaching / Learning / Weightage</td><td colspan="4">Modes of Continuous Assessment / Evaluation</td></tr>
<tr><td colspan="5">Hours Per Week</td><td colspan="2">Theory (100)</td><td>Practical/Oral (25)</td><td>Term Work (25)</td><td>Total</td></tr>
<tr><td>Theory</td><td>Tutorial</td><td>Practical</td><td>Contact Hours</td><td>Credits</td><td>IA</td><td>ESE</td><td>PR</td><td>TW</td><td rowspan="2">100</td></tr>
<tr><td>3</td><td>-</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>-</td><td>-</td></tr>
<tr><td colspan="9">IA: In-Semester Assessment - Paper Duration – 1.5 Hours
ESE : End Semester Examination - Paper Duration - 3 Hours
The weightage of marks for continuous evaluation of Term work/Report: Formative (40%), Timely completion of practical (40%) and Attendance (20%)</td></tr>
<tr><td colspan="9">Prerequisite: None</td></tr>
</table>

Course Objectives:

Course intended to deliver the fundamental knowledge of basic principles involved in design of new product and its development.

Course Outcomes:

SN	Course Outcomes	Cognitive levels as per bloom's Taxonomy
1	Identify design and development process of industrial products, considering ergonomic requirements.	L1, L2
2	Explain market requirements and manufacturing aspects of industrial design.	L1, L2, L3
3	Identify consumer products, functions and use.	L1, L2, L3
4	Explain aesthetic concept, symmetry.	L1, L2, L3, L4
5	Explain economic considerations, value analysis and cost reduction.	L1, L2
6	Employ standard organization structure, standardization, record keeping.	L1, L2, L4, L5, L6

Detailed Syllabus

Module No.	Topics	Hrs.	Cognitive levels as per bloom's Taxonomy
1	**Introduction-Approach to Industrial Design** Approach to industrial product based on idea generation and innovations to meet the needs of the developing society. Design and development process of industrial products, various steps such as creative process involved in idea marketing, designers, mind- criticism, design process, creation. Ergonomics and aesthetic requirements of product design, quality and maintainability consideration in product design, Use of modeling technique, prototype designs, conceptual design.	4	L1, L2
2	**Industrial Product Design** General design situations, setting specifications, requirements and ratings, their importance in the design, Study of market requirements and manufacturing aspects of industrial designs. Aspects of ergonomic design of machine tools, testing equipment, instruments, automobiles, process equipment etc. Convention of style, from and color of industrial design.	8	L1, L2, L3
3	**Design of Consumer Product** Functions and use, standard and legal requirements, body dimensions. Ergonomic considerations, interpretation of information, conversions for style, forms, colors.	8	L1, L2, L3, L4
4	**Aesthetic Concepts** Concept of unity order with variety, concept of purpose, style and environment, Aesthetic expression of symmetry, balance, contrast and continuity, proportion, rhythm, radiation. Form and style of product: visual effect of line and form, mechanics of seeing, psychology of seeing, influence of line and form, Components of style, Basic factors, effect of color on product appearance, color composition, conversion of colors of engineering products.	8	L1, L2, L3
5	**Economic Considerations** Selection of material, Design for production, use of standardization, value analysis and cost reduction, maintenance aspects in design.	10	L1, L2, L3, L4
6	**Design Organization** Organization Structure, Designer position, Drawing office procedure, Standardization, record keeping, legal procedure of Design patents.	7	L1, L2, L4, L5,L6

Books and References:

SN	Title	Authors	Publisher	Edition	Year
1	Industrial Design for Engineers	W. H. Mayall	London Hiffee books Ltd	-	1967
2	Problems of Product Design and Development	Hearn Buck	Pergamon Press	-	-
3	Industrial Designs in Engineering	Charles H. Fluerichem	-	-	-
4	Material of Invention: Materials and Design	Ezio Manzini	The MIT Press	-	1989
5	The Science of Engineering Design	Percy H. Hill	Holt, Rinehart and Winston Publication	-	1970

Online References:

Sr.No.	Website Name	URL	Modules Covered
1	https://nptel.ac.in	https://nptel.ac.in/courses	M1-M6