

UNIVERSITY OF MUMBAI



Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Mechanical Engineering

Second Year with Effect from AY 2017-18

Third Year with Effect from AY 2018-19

Final Year with Effect from AY 2019-20

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17.

Semester VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
MEC701	Machine Design II	04	--	04	--	04
MEC702	CAD/CAM/CAE	04	--	04	--	04
MEC703	Production Planning and Control	04	--	04	--	04
MEDLO 703X	Department Level Optional Course III	04	--	04	--	04
ILO701X	Institute Level Optional Course I [#]	03	--	03	--	03
MEL701	Machine Design II	--	02	--	01	01
MEL702	CAD/CAM/CAE	--	02	--	01	01
MEL703	Production Planning and Control	--	02	--	01	01
MEL704	Project I	--	06	--	03	03
Total		19	12	19	06	25

Course Code	Course Name	Examination Scheme									
		Theory					End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Internal Assessment			Avg						
		Test1	Test 2	Avg							
MEC701	Machine Design II	20	20	20	80	03	--	--	100		
MEC702	CAD/CAM/CAE	20	20	20	80	03	--	--	100		
MEC703	Production Planning and Control	20	20	20	80	03	--	--	100		
MEDLO 703X	Department Level Optional Course III	20	20	20	80	03	--	--	100		
ILO701X	Institute Level Optional Course I [#]	20	20	20	80	03	--	--	100		
MEL701	Machine Design II	--	--	--	--	--	25	25	50		
MEL702	CAD/CAM/CAE	--	--	--	--	--	25	25	50		
MEL703	Production Planning and Control	--	--	--	--	--	25	25	50		
MEP701	Project I	--	--	--	--	--	50	--	50		
Total				100	400		125	75	700		

Course Code	Department Level Optional Course III	Course Code	Institute Level Optional Course I [#]
MEDLO7031	Mechanical Vibrations	ILO7011	Product Lifecycle Management
MEDLO7032	Automobile Engineering	ILO7012	Reliability Engineering
MEDLO7033	Pumps, Compressors and Fans	ILO7013	Management Information System
MEDLO7034	Computational Fluid Dynamics	ILO7014	Design of Experiments
		ILO7015	Operation Research
		ILO7016	Cyber Security and Laws
		ILO7017	Disaster Management and Mitigation Measures
		ILO7018	Energy Audit and Management
		ILO7019	Development Engineering

Common with all branches

Course Code	Course/Subject Name	Credits
MEC701	Machine Design – II	4

Objective:

1. To acquaint with functional and strength design principles of important machine elements
2. To familiarise selection of standard elements such as rolling element bearings, belts etc.

Outcomes: Learner will be able to...

1. Select appropriate gears for power transmission on the basis of given load and speed
2. Design gears based on the given conditions.
3. Select bearings for a given applications from the manufacturers catalogue.
4. Select and/or design belts and flywheel for given applications
5. Design cam and follower mechanisms.
6. Design clutches and brakes

Module	Details	Hrs.
01	Design of Gears: 1.1 Gears: Design of spur, helical, bevel and worm gears with strength, wear and thermal considerations 1.2 Gear Box: Two stage Gear box with fixed ratio consisting of spur, helical and bevel gear pairs: gear box housing layout and housing design	14
02	2.1 Rolling Contact Bearings: Types of bearing and designation, selection of rolling contact bearings based on constant / variable load & speed conditions (includes deep groove ball bearing, cylindrical roller, spherical roller, taper roller, self-aligning bearing and thrust bearing)	05
03	1.1 Sliding Contact Bearings: Design of hydro dynamically lubricated bearings (self-contained), Introduction to hydro static bearings, Types and selection of Mechanical seals	05
04	4.1 Design of Cams and Followers: Design of Cam and Roller follower mechanisms with spring and shaft	06
05	5.1 Design and selection of Belts: Flat and V-belts with pulley construction 5.2 Design of Flywheel – Introduction, Fluctuation of energy and speed, turning moment diagram, estimating inertia of flywheel for reciprocating prime movers and machines, Weight of the flywheel, flywheel for punches, rim constructions, stresses in rims and arms, Construction of flywheel 5.3 Design and selection of standard roller chains	10
06	6.1 Design of Clutches: Introduction, types, Basic theory of plate and cone type clutches, Design of single plate, multi-plate and cone clutches, with spring, lever design and thermal, wear considerations. 6.2 Design of Brakes: Design of single shoe brake	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Design of Machine Elements - V.B. Banadari, Tata McGraw Hill Publication
2. Design of Machine Elements - Sharma, Purohil. Prentice Hall India Publication
3. Machine Design -An Integrated Approach - Robert L. Norton, Pearson Education
4. Machine Design by Pandya & Shah, Charotar Publishing
5. Mechanical Engineering Design by J.E.Shigley, McGraw Hill
6. Recommended Data Books - PSG
7. Machine Design by Reshetov, Mir Publication
8. Machine Design by Black Adams, McGraw Hill
9. Fundamentals of Machine Elements by Hawrock, Jacobson McGraw Hill
10. Machine Design by R.C.Patel, Pandya, Sikh, Vol-I & II C. Jamnadas & Co
11. Design of Machine Elements by V.M.Faires
12. Design of Machine Elements by Spotts

Course Code	Course/Subject Name	Credits
MEC702	CAD/CAM/CAE	04

Objectives

1. To introduce new and exciting field of Intelligent CAD/CAM/CAE with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.
3. To develop New API for CAD

Outcomes: Learner will be able to...

1. Identify proper computer graphics techniques for geometric modelling.
2. Transform, manipulate objects & store and manage data.
3. CAM Toolpath Creation and NC- G code output.
4. Use rapid prototyping and tooling concepts in any real life applications.
5. Identify the tools for Analysis of a complex engineering component.

Modules	Details	Hrs.
01	Computer Graphics and Techniques for Geometric Modeling Computer Graphics: Two dimensional computer graphics, vector generation, the windowing transformation, Three dimensional Computer graphics, viewing transformation, Homogeneous coordinates, Perspective projection, Hidden line removal & hidden surface removal algorithm, light & shade ray tracing. The parametric representation of geometry, Bezier curves, Cubic Spline curve, B-Spline curve, parametric representation of line, circle, ellipse & parabola. Constructive solid geometry (CSG), Boundary Representation (B-Rep), Wire Frame Modeling, Solid Modeling, Surface Modeling, Parametric Modeling, feature based modeling, Feature recognition, Design by feature.	08
02	Transformation, Manipulation & Data Storage 2D & 3D Transformations (Translation, Rotation, & Scaling & Magnification), Concatenations, Matrix representation, Problems & object oriented programming on Transformations. Object transformation, mirror transformation, Artificial Intelligence in Design & Manufacturing, Representation of Knowledge, and Knowledge base Engineering. Application Programming Interface (API) Concept of customizing applications by writing programs, Fusion Object Model, Creating Scripts and Add-Ins, Document and assembly structure, Attributes, Creating Programs for Assemblies, Joint, B- Rep & Geometry.	08
03	Design to Manufacturing (CAM) 2D Machining Strategies, 3D Machining Strategies, Fixture Component Terminology, Work Coordinate System Terminology, Create setups, Apply 2D operations, Facing, 2D adaptive clearing, 2D contour. Chamfer milling, Bore ,Tool simulation and stock material removal , Produce setup sheets , Product NC code via post processing,	08
04	Computer Aided Engineering (CAE) Fundamentals of computer aided engineering, CAE includes mass property calculations, kinematic analysis and animation (movement, visualization, simulation and FEA). Case study based on modeling and analysis of structural, thermal/fluid, and dynamic (vibration analysis) system. Parameter optimization.	08
05	Computer Integrated Manufacturing & Technology Driven Practices Introduction, Evolution, Objectives, CIM Hardware and Software, CIM Benefits, Nature and role of the elements of CIM, Identifying CIM needs, Data base requirements of CIM, Role of CAD/CAM in CIM, Obstacles to Computer Integrated Manufacturing, Concept of the future CIM systems, Socio -techno- economic aspects of CIM.	08

06	<p>Rapid Prototyping and Tooling Introduction to RP, Technology Description, Overview of RP, Benefits and Application. RP Processes: Process overviews, STL file Generation, Classes of RP systems: Stereolithography Approach (SLA), SLA with photo-polymerization (mathematical modelling of the process), SLA with liquid thermal polymerization, Selective Laser Sintering (SLS), Fused deposition modelling, Laminated object manufacturing, Laser powder forming. Prototype properties: Material properties, colour, dimensional accuracy, stability, surface finish, machinability, environmental resistance, operational properties. RP Applications: Design, Concept Models, Form & fit checking, Functional testing, CAD data verification, Rapid Tooling, Rapid manufacturing, Science & Medicine, RP processes for MEMS, Photolithography, Direct Laser Writer, Bulk Lithography for 3D micro fabrication (Modelling of beam propagation and curing in resin system).</p>	08
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Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. "CAD/CAM Computer Aided and Manufacturing" by Mikell P. Groover and Emory W. Zimmers, Jr., *Eastern Economy Edition*
2. "CAD/ CAM , Theory & Practice" by Ibrahim Zeid, R. Sivasubramanian, *Tata McGraw Hill Publications*
3. "Computer Graphics" by Donald Hearn and M. Pauline Baker, *Eastern Economy Edition*
4. "CAD/CAM Principles, Practice and Manufacturing Management" by Chris McMahon, Jimmie Browne, *Pearson Education*
5. "CAD/CAM/CIM" by P. Radhakrishan, S. Subramanyan, V. Raju, *New Age International Publishers*
6. "CAD/CAM Principles and Applications" by P.N. Rao, *Tata McGraw Hill Publications*
7. "Principle of Computer Graphics" by William .M. Neumann and Robert .F. Sproul, *McGraw Hill Book Co. Singapore.*
8. David L. Goetsch, Fundamental of CIM technology ,Delmar publication
9. David Bedworth, Computer Integrated Design and Manufacturing, *McGraw Hill.*
10. "CNC Machines" by B.S. Pabla and M. Adithan, *New Age International Publishers.*
11. "Numerical Control and Computer Aided Manufacturing" , T.K. Kundra, P.N. Rao, N.K. Tiwari, *Tata McGraw Hill*
12. "CNC Technology and Programming", Krar, S., and Gill, A., *McGraw Hill publishers*
13. "Computer Integrated Manufacturing- An Introduction with Case Studies" by Paul G. Ranky, *Prentice Hall International*

14. "Flexible Manufacturing Systems" by H.K. Shivanand, M.M. Benal, V.Koti, *New Age International Publishers*
15. "Automation, Production Systems and Computer Integrated Manufacturing ", Groover M.P., *Prentice-Hall of India Pvt. Ltd*
16. "Mathematical Elements for Computer Graphics", Rogers D F I and Adams J A, McGraw-Hill.
17. "Computer Integrated Manufacturing Hand Book" by Eric Teicholz, Joel N. Orr, McGraw Hill International Editions
18. "Rapid Prototyping" Chee Kai ChuaWorld Scientific Publishing
19. "Rapid Prototyping:Principles and Applications" RafiqNoorani, Wiley
20. "Rapid Prototyping:Principles and Applications" C.K. Chua,K.F.Leong, C.S. Lim World Scientific Publishing
21. "Rapid Prototyping and Manufacturing" P. F. Jacobs, Society of Manufacturing Engineers.

Course Code	Course/Subject Name	Credits
MEC703	Production Planning and Control	4

Objectives:

1. To provide an exposure to Production Planning & Control (PPC) and its significance in Manufacturing Industries
2. To give insight into the ongoing & futuristic trends in the control of inventory
3. To appraise about need and benefits of planning functions related to products and processes
4. To give exposure to production scheduling and sequencing so as to optimise resources

Outcomes: Learner will be able to...

1. Illustrate production planning functions and manage manufacturing functions in a better way
2. Develop competency in scheduling and sequencing of manufacturing operations
3. Forecast the demand of the product and prepare an aggregate plan
4. Develop the skills of Inventory Management and cost effectiveness
5. Create a logical approach to Line Balancing in various production systems
6. Implement techniques of manufacturing planning and control

Module	Details	Hrs
1	<p>Concepts of PPC:</p> <p>1.1. Manufacturing systems- components and types, need for PPC, functions of PPC, relationship of PPC with other functions</p> <p>1.2. Factors influencing PPC in the organization, manufacturing methods- projects & jobbing products, batch, mass / flow production, continuous / process production.</p> <p>1.3. Organization of PPC- status of PPC department, internal structure, degree of centralization, PPC as an integrated approach</p> <p>1.4. Prerequisites of PPC – data pertaining to design, equipment, raw materials, tooling, performance standards, labour and operating systems</p>	06
2	<p>Forecasting, Aggregate planning, Capacity planning</p> <p>2.1. Forecasting: Need for forecasting, role of forecasting in PPC, forecasting methods of qualitative type like judgment techniques. Forecasting methods of quantitative types like time series analysis, least square method, moving averagemethod, exponential smoothing method. Forecasting Errors and Forecasting Bias</p> <p>2.2. Aggregate planning : Concept of aggregate planning, decision rules, strategies and methods</p> <p>2.3. Capacity Planning: Measurement of capacity, Measures of capacity, Factors influencing effective capacity, short range, medium range and long range capacity planning, Rough cut capacity planning.</p>	08
3	<p>Inventory Control:</p> <p>3.1. Basic concepts of inventory, Types of inventory, purpose of holding stock and influence of demand on inventory, Costs associated with Inventory management.</p> <p>3.2. Inventory Models: Deterministic models - instantaneous stock replenishment model, Production model, planned shortages and price discount model, Probabilistic models- fixed quantity system(Q-system) and Fixed period system (p-system)</p> <p>3.3. Selective Inventory Control techniques - ABC analysis, HML analysis and VED analysis</p>	08
4	<p>Process Planning and Line Balancing</p> <p>4.1 Process planning: Prerequisite information requirement, steps in process planning, process planning in different situations, documents in process planning, machine / process selection & Computer Aided Process Planning</p> <p>4.2 Line Balancing: objectives, constraints, terminology in assembly line, heuristic methods like Kilbridge-Wester, Largest Candidate rule, Rank positional weight</p>	08
5	<p>Production Scheduling and Sequencing</p> <p>5.1 Scheduling: Inputs for scheduling, loading and scheduling devices, factors influencing scheduling, scheduling techniques, use of Gantt Charts and basic scheduling problems.</p>	10

	Project scheduling by using elements of network analysis –PERT & CPM, cost analysis & crashing, resource leveling 5.2 Sequencing: Product sequencing, dispatching, progress report & expediting and control. Johnson’s Rule for optimal sequence of N jobs on 2 machine. Process n Jobs on 3 Machines (n/3 problem) and Jackson Algorithm. Processing of 2 Jobs on m Machine (2/m) problem	
6	MRP, MRP II, ERP 6.1. Material Requirement planning(MRP) and Manufacturing Resource Planning (MRP-II) - general concepts, types of demands, Inputs to MRP, MRP objectives, outputs of MRP, Estimation of planned order releases. Benefits and Limitations of MRP II 6.2. Enterprise Resource Planning (ERP): Evolution, features, purpose of modeling an enterprise, information mapping, generic model of ERP, Modules in ERP, Methodology of implementation, critical success factors of ERP, Case studies of success and failure of ERP implementations, ERP packages	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References

1. Production Planning and Control – Samuel Eilon.
2. Production Planning and Control – L C Jamb
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, William L. Berry & Others- Galgotia Publishers
6. Manufacturing Process Planning and Systems Engineering, Anand Bewoor- Dreamtech Press
7. Production and Operations Management, S.N. Chary- TMH publishing company
8. Modernization & Manufacturing Management, L.C. Jhamb - Everest Publishing House

Course Code	Course/Subject Name	Credits
MEDLO7031	MECHANICAL VIBRATION	4

Objectives:

1. To study basic concepts of vibration analysis
2. To acquaint with the principles of vibration measuring instruments
3. To acquaint with the practices of monitoring health conditions of the systems

Outcomes: Learner will be able to...

1. Develop mathematical model to represent dynamic system.
2. Estimate natural frequency of mechanical element / system.
3. Analyse vibratory response of mechanical element / system.
4. Estimate the parameters of vibration isolation system and
5. Control the vibrations to the acceptable level using basic vibration principles
6. Handle the vibration measuring instruments

Module	Details	Hrs.
1	1.1 Basic Concepts of Vibration: Introduction, classification, terminology, modelling vibration analysis 1.2 Free Undamped Single Degree of Freedom Vibration System: Longitudinal, transverse, torsional, vibration system, methods for formulation of differential equations by D'Alembert's Principle, Newton, Energy, Lagrangian and Rayleigh's method	08
2	Multi Degree of Freedom System: 2.1 Undamped free vibration: Free vibration equation of motion, Influence coefficients (stiffness and flexibility), Reciprocity theorem, Generalized Coordinates, and Coordinate Coupling, Lagrangian equations, Rayleigh and Dunkerley method, two rotor and geared systems 2.2 Eigen Values and Eigen vectors: for translatory and torsional two d.o.f. systems, Matrix method, Holzer's method (translatory and torsional unbranched systems)	10
3	Free Damped Single Degree of Freedom Vibration System: Types of dampers, Viscous damped system- translatory and rotary systems, Coulomb's damping- final rest position of body in coulomb damping, motion with negative damping factor,	06
4	4.1 Forced Single Degree of Freedom Vibratory System: Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation 4.2 Vibration Isolation and Control: Conventional Methods: By mass /Inertia, stiffness, damping (vibration isolation principles) Force Transmissibility, motion transmissibility, typical isolators & mounts. Introduction to Semi-Active and Active Vibration control.	10
5	5.1 Vibration Measuring Instruments: Principle of seismic instruments, vibrometer, accelerometer- undamped, damped 5.2 Introduction to Conditioning Monitoring and Fault Diagnosis: Introduction to conditioning monitoring and fault diagnosis,Condition & Vibration Monitoring Techniques, Condition / vibration monitoring data collection. Signature analysis	07
6	Non-Linear Vibration: Basics of Non-linear vibration, systems with non-linear elastic properties, free vibrations of system with non-linear elasticity and damping, phase –plane technique, Duffing's equation, Jump phenomenon, Limit Cycle, Perturbation method.	07

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

References:

1. Mechanical Vibrations by S.S.Rao, fourth edition, Pearson Education
2. Mechanical Vibrations by G. K. Grover
3. Fundamentals of Mechanical Vibration by S.Graham Kelly, Tata McGraw Hill
4. Vibration Analysis by P. Srinivasan, Tata McGraw Hill
5. Mechanical Vibrations- Schaum's outline series, William W.Seto, McGraw Hill
6. Theory and Practice of Mechanical Vibrations by J.S.Rao, K. Gupta, New Age International Publications

7. Mechanical Vibrations by Den, Chambil, Hinckle
8. Mechanical Vibrations by J.P.Den Hartog, McGraw Hill Book Company Inc
9. Introduction to Dynamics and Control by Leonard Meirovitch, Wiley, New York
10. Elements of Vibration Analysis by Leonard Meirovitch, McGraw-Hill, New York
11. Dynamics and Control of Structures by Leonard Meirovitch, Wiley, New York
12. Matrices and Transformations by Antony J. Pettofrezzo, Dover, New York
13. Principles of Vibration by Benson H. Tongue, Oxford University Press
14. Theory of Vibration with Applications, by W. Thomson, 2nd edition, Pearson Education
15. Vibrations by Balakumar Balachandan, Edward Magrab, Cengage Learning

Course Code	Course/Subject Name	Credits
MEDLO7032	AUTOMOBILE ENGINEERING	04

Objectives:

1. To impart the understanding of important mechanical systems of an automobile
2. To provide insight into the electrical systems of an automobile
3. To familiarize with the latest technological developments in automotive technology

Outcomes: Learner will be able to...

1. Illustrate the types and working of clutch and transmission system.
2. Demonstrate the working of different types of final drives, steering gears and braking systems
3. Illustrate the constructional features of wheels, tyres and suspension systems
4. Demonstrate the understanding of types of storage, charging and starting systems
5. Identify the type of body and chassis of an automobile
6. Comprehend the different technological advances in automobile

Module	Details	Hrs
1	<p>Clutch : Requirements of Clutches, Types of Clutches; Single Plate, Multi-plate, Wet Clutch, Semi-centrifugal, Centrifugal. Clutch materials. Clutch operating mechanisms; Mechanical, Electric, Hydraulic and Vacuum. Free Pedal Play.</p> <p>Transmission: Necessity of gear box. Sliding mesh, Constant mesh, and Synchromesh Gear selector mechanisms. Overdrives and hydrodynamic torque converter, Trouble shooting and remedies.</p> <p>Propeller Shaft and Axle: Propeller shafts and universal joints: Types and construction, Different types of universal joints and constant velocity joints Types of live axles; semi, three quarter and full floating axles Types of Front Stub Axles; Elliot, Reverse Elliot, Lamoine and Reverse Lamoine</p>	09
2	<p>Final Drive and Differential : Types of Final drive; spiral, bevel, Hypoid and worm drives. Necessity of differential, Working of differential, Conventional and non-slip differential, Trouble shooting and remedies</p> <p>Steering System : Steering geometry, Steering requirements, Steering linkages and steering gears. Over steer and under steer, Cornering power, Reversibility of steering gears.</p> <p>Braking System: Requirement of brake, Classification of brakes, Brake Actuation Methods; Mechanical, Hydraulic, Pneumatic, Electro and vacuum brakes. Types of Disc brakes and Drum Brakes, Brake trouble shooting, Introduction to antilock braking system (ABS)</p>	08
3	<p>Suspension System Objects of suspension, Basic requirements, Sprung and un-sprung mass, Types of Independent and rigid axle suspension. Air suspension and its features. Pitching, rolling and bouncing. Shock absorbers and its types</p> <p>Wheels and Tyres: Requirements of wheels and tyres. Types of wheels, types of tyres and types of carcass</p>	07
4	<p>Automotive Electrical System : Storage System: Lead-Acid Battery; construction, working, ratings, types of charging methods, Alkaline, ZEBRA, Sodium Sulphur and Swing batteries</p> <p>Charging System:</p>	06

	Dynamo: Principle of operation, Construction and Working. Regulators, combined current and voltage regulator. Alternator: Principle of operation, Construction, Working. Rectification from AC to DC Starting system: Requirements, Various torque terms used, Starter motor drives; Bendix, Rubber compression, Compression Spring, Overrunning Clutch. Starter motor solenoids and switches	
5	Body Engineering: Importance of Body design, Materials for body construction-Styling forms-Coach and bus body style, layouts of passenger cars, Bus and truck bodies. Chassis types and structure types: Open, Semi integral and integral bus structure Frames: functions and types of frames, Loads on frames, Load distribution of structure, Location of power plant	06
6	Recent trends in Automobiles : Intelligent Vehicle Systems : Cruise Control, Adaptive Cruise Control (ACC), Electronic Stability Program (ESP), Electronic Brake Distribution (EBD), Traction Control System (TCS). Integrated Starter Alternator (ISA)	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference Books:

1. Automobile Engineering, Kirpal Singh, Vol I & II, Standard publishers Distributors ,Delhi
2. The Automobile by Harbans Singh Reyat
3. The Automobile Engineering by T.R. Banga and Nathu Singh
4. Automotive Engineering Fundamentals by Richard Stone, Jeffrey K. Ball,SAE International
5. Vehicle body engineering by J Powlowski
6. Automobile Mechanics, N. K. Giri, 8thEdition, Khanna Publishers
7. Bosch Automotive Hand Book, 6thEdition, SAE Publications
8. Automotive Mechanics by William H. Crouse and Donald L. Anglin, 10th Edition, McGraw Hill
9. Motor vehicles by T. K. Garrett, K. Newton and W. Steeds
10. Automotive Mechanics by Joseph Heitner
11. Automobile Electrical and Electronics by Tom Denton
12. Automotive Electrical Equipment by P. L. Kohli
13. Computerised Engine Control by Dick H. King

Course Code	Course/Subject Name	Credits
MEDLO7033	Pumps, Compressors and Fans	4

Objectives

1. To study of Different types of Pumps, Compressors & Fans
2. To familiarise design aspects of Pumps, Compressors & Fans

Outcomes: Learner will be able to...

1. Select suitable Pump
2. Design a reciprocating pump and analyse its performance
3. Design a centrifugal pump and analyse its performance
4. Demonstrate basic principles of fans and blowers
5. Design fan/blower and analyse its performance
6. Design a compressor and analyse its performance

Module	Detailed Contents	Hrs.
01	Introduction to Fluid Machinery: Introduction to pumps, Introduction to blowers and compressors, Basic equations of energy transfer between fluid and rotor, Performance characteristics, Dimensionless parameters, Specific speed, stage velocity triangles, work and efficiency.	04
02	Reciprocating Pumps and Centrifugal Pumps: Introduction: Types, Component and Working of Reciprocating pump and Centrifugal Pumps, Discharge, Work done and power required to drive for single acting and double acting, Coefficient of discharge, slip, Effect of acceleration of piston on velocity and pressure, indicator diagram, Air Vessel, Operating characteristics.	06
03	Design & Analysis of Pumps: Design procedure and design optimization of Pumps, selection of pumps, Thermal design- Selection of materials for high temperature and corrosive fluids, Hydraulic design- Selection of impeller and casing dimension using industrial manuals	08
04	Introduction to Fans, Blowers and Compressors: Classification of blowers, Basics of stationary and moving air, Eulers characteristics, velocity triangles and operating pressure conditions, Equations for blowers, Losses and hydraulic efficiency, flow through impeller casing, inlet nozzle, Volute, diffusers, leakage, mechanical losses, surge and stall, Applications of blowers and fans Compressors: Basic theory, classification and application, Working with enthalpy-entropy diagram	06
05	Design and Analysis of Fans and Blowers: Rotor design airfoil theory, vortex theory, cascade effects, degree of reaction, Design procedure for selection and optimization of Blowers. Stage pressure rise, stage parameters and design parameters, Design of impeller and casing dimension in aerodynamic design	06
06	Design & Analysis of Compressors: Construction and approximate calculation of centrifugal compressors, impeller flow losses, slip factor, diffuser analysis, performance curves of centrifugal compressors, Basic design features of axial flow compressors; velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage of axial flow compressors	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Reference Books:

1. Principles of Turbo machinery by Shepherd, D.G., Macmillan
2. Centrifugal Pump Design by John Tuzson, John Wiley
3. Blowers and Pumps by Stepanff, A.J., John Wiley and Sons Inc.
4. Centrifugal pumps and blowers by Austin H. Chruch, John Wiley and Sons
5. Centrifugal Pumps Design and Applications by Val S.Labanoff and Robert Ross, Jaico P House
6. Pump Hand Book by Igori Karassik, McGraw-Hill International Edition
7. Pumps by G.K.Sahu, New age international
8. Turbine, Compressors and Fans by S.M.Yahya, Tata Mc-Graw Hill Publishing Company
9. Fluid Mechanics and Hydraulic Machines by R. K. Bansal, Laxmi Publication
10. Gas Turbines by V. Ganeshan, Tata Mc-Graw Hill Publishing Company
11. Steam and Gas Turbine by R. Yadav, Central Publishing House, Allahabad

Course Code	Course/subject Name	Credits
MEDLO7034	Computational Fluid Dynamics	4

Objectives:

1. To study basic principles of Computational Fluid Dynamics
2. To study grid generation and discretization methods

Outcomes: Learner will be able to...

1. Demonstrate methodology to work with CFD
2. Illustrate principles of grid generation and discretisation methods
3. Identify and apply specific boundary conditions relevant to specific application
4. Decide solution parameters relevant to specific application
5. Analyze the results and draw the appropriate inferences
6. Demonstrate basic principles of FVM

Module	Detailed Contents	Hrs.
01	Introduction: What is CFD, Scope and Application of CFD, Methods of Predictions like Experimental and theoretical, Working of Commercial CFD Software, Solution methodology-Preprocessing, Solver, Post processing.	04
02	Mathematical description of Physical Phenomenon: Governing Differential Equations, Meaning of Differential equation, The Continuity Equation, A Momentum equation, The Energy Equation, The General Differential Equation, Boundary Conditions, Initial and Boundary Conditions, Initial and Boundary Value problems.	06
03	Grid Generation and Discretization Methods: Structured and unstructured Grids: O-type, H-type, C-type of Structured Grid Generation, Mesh Adaptation. The Nature of Numerical Methods: The Discretization Concept, The Structure of the Discretization Equation. Basic discretization techniques applied to model equations and systems of equations: finite difference, finite volume and finite element methods. Methods of Deriving the Discretization Equations, Taylor-Series Formulation, Variational Formulation, Method of Weighted Residuals, Control Volume Formulation	08
04	Heat Conduction, Convection and Diffusion: Steady One-dimensional Conduction, Unsteady One-dimensional Conduction, Two and Three-dimensional Situations, Over relaxation and Under relaxation, Steady One-dimensional and Two Dimensional Convection-Diffusion, Unsteady One-dimensional Convection.	
05	Incompressible Fluid Flow: Governing Equations, Stream Function-Vorticity Method, Determination of Pressure for Viscous Flow, The SIMPLE, SIMPLER Algorithm, Introduction to Turbulence Modeling, Basic Theories of Turbulence, The Time-Averaged Equations for Turbulent Flow.	
06	Finite Volume Methods: FVM solutions to steady one, two and three dimensional diffusion problems and unsteady one and two dimensional diffusion problems, FVM solutions to convection-diffusion problems - one and two dimensional, steady and unsteady; Advection schemes; Pressure velocity coupling	08

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

References:

1. An introduction to computational fluid dynamics-The finite volume method, Versteeg.H.K. , Malalasekera.W., Prentice Hall
2. Computational Fluid Mechanics and Heat Transfer, Anderson, D.A., Tannehill, I.I., and Pletcher, R.H., Hemisphere Publishing Corporation, New York, USA, 1984
3. Introduction to Computational Fluid Dynamics, Niyogi P. ,Laha M.K., Chakrabarty S.K., Pearson Education, India
4. Computational Fluid Flow and Heat Transfer, Muralidhar, K.,andSundararajan,T., Narosa Publishing House ,New Delhi
5. Computer Simulation of flow and heat transfer, Ghoshdasdidar, P. S., Tata McGraw-Hill Publishing Company Ltd
6. Finite Element Programming of the Navier Stock Equation, Taylor, C and Hughes J.B., Pineridge Press Ltd.U.K.
7. Computational Techniques for Fluid Dynamics: Fundamental and General Techniques, Fletcher, C.A.J., Springer-Verlag
8. Numerical Fluid Dynamics, Bose, T. K., Narosa Publishing House
9. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press
10. Anderson, J.D. Computational Fluid Dynamics, McGraw Hill

Course Code	Course Name	Credits
ILO 7011	Product Life Cycle Management	03

Objectives:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Outcomes: Learner will be able to...

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies: Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life	05

	Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
06	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO 7012	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

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3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO 7013	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

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End Semester Examination:

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4. Only **Four questions need to be solved.**

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO 7014	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	Introduction 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	Fitting Regression Models 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	Two-Level Factorial Designs 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	Two-Level Fractional Factorial Designs 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	Response Surface Methods and Designs 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07

06	Taguchi Approach 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04
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Assessment:

Internal Assessment for 20 marks:

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4. Only **Four questions need to be solved.**

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Credits
ILO 7015	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	<p>Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research</p> <p>Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis</p> <p>Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.</p> <p>Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem</p> <p>Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.</p>	14
02	<p>Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population</p>	05
03	<p>Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation</p>	05
04	<p>Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.</p>	05

05	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Course Code	Course Name	Credits
ILO 7016	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	Tools and Methods Used in Cyberline Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	Indian IT Act. Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>
9. Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

Course Code	Course Name	Credits
ILO 7017	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to...

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.	09

	5.2 International relief aid agencies and their role in extreme events.	
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
 2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
 3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
 4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
 5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
 6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
 7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.
- (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO 7018	Energy Audit and Management	03

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.

Outcomes: Learner will be able to...

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10

05	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

REFERENCES:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by 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
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	Development Engineering	03

Objectives:

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a ‘good’ human being, a ‘good’ professional, a ‘good’ society and a ‘good life’ in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to...

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people’s participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	04
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	06
4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved**

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Course Code	Course Name	Credits
MEL701	Machine Design –II	1

Objectives:

1. To familiarise applications of strength design principles for various machine elements
2. To make conversant with preparation of working drawings

Outcomes: Learner will be able to...

1. Design gears based on the given conditions
2. Design gearbox for a given application
3. Design cam & followers for a given condition
4. Design clutches for a given application
5. Design brakes for given condition
6. Select bearings for a given applications from the manufacturers catalogue

Term Work: (Comprises a and b)

a)

1. **Term work** - Shall consist of design and detailed assembly drawing of minimum two design problems from the mentioned list (computer aided drawing on **A3 size sheets**):
 1. Design of Gears and gear box
 2. Design of cam and followers
 3. Design of clutches
 4. Design of brakes
2. **Course Project:** Students in a group of two to four will be able to design and prepare working drawings of any system having minimum 5 to 6 components by applying the knowledge gained during the course.

b) Assignment : Each assignment containing at least 2- numerical based on following topics. These design exercises should be in the form of design calculations with sketches and/ or drawings.

1. Rolling contact bearings
2. Sliding contact bearing
3. Design of belt, chain and flywheel

The distribution of marks for term work shall be as follows:

Exercises & Drawing sheets:	15 Marks
Course Project:	05 Marks
Attendance:	05 Marks

End Semester Practical/Oral examination:

1. Each student will be given a small task of design, based on syllabus, which will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:

Design Task:	15 marks
Oral:	10 marks
3. Evaluation of practical/oral examination to be done based on the performance of design task.
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL702	CAD/CAM/CAE	01

Objectives

1. To introduce new and exciting field of Intelligent CAD/CAM/CAE with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.
3. To develop New API for CAD

Outcomes: Learner will be able to...

1. Identify proper computer graphics techniques for geometric modelling.
2. Transform, manipulate objects as well as store and manage data.
3. Create CAM Toolpath and prepare NC- G code
4. Apply rapid prototyping and tooling concepts in any real life applications.
5. Identify the tools for Analysis of a complex engineering component.

List of Exercises

1. Programming for transformations,
2. API on Creating As built joints, Slider Joint Motion
3. Get the physical Properties API
4. Get the circle and arc data from the edge
5. Sketch spline through points creation : API
6. Solid modeling using any 3D modeling software
7. Part programming and part fabrication on CNC trainer (Turning / Milling)
8. Geometrical optimization of any mechanical component using computer aided engineering concepts. (Shape optimization)
9. Development of physical 3D mechanical structure using any one of the rapid prototyping processes.

Term Work

Term work shall consist of

- a. Any four exercises from 1 to 6 of above list
- b. Part programming and part fabrication on CNC trainer
- c. A course project in a group of not more than four students based on 8 and 9 of above list

The distribution of marks for term work shall be as follows:

- Exercises : 15 Marks
- Course Project : 05 Marks
- Attendance : 05 Marks

Assessment:

End Semester Practical/Oral Examination:

1. Each student will be given a small task of design based on syllabus, which will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:

Design Task:	15 marks
Oral:	10 marks
3. Evaluation of practical/oral examination to be done based on the performance of design task
4. Students work along with evaluation report to be preserved till the next examination

Course Code	Course Name	Credits
MEL703	Production Planning and Control	01

Objectives:

1. To provide an exposure related to Production Planning & Control (PPC)
2. To give exposure to production scheduling and sequencing

Outcomes: Learner will be able to...

1. Prepare a process sheet
2. Prepare a Gantt Chart
3. Forecast the demand of the product and prepare an aggregate plan.
4. Perform ABC analysis of a given problem
5. Develop the skills of Inventory Management and cost effectiveness.
6. Create a logical approach to Line Balancing for various production systems.

Term Work

The Term work shall comprise of the following:

At least six laboratory exercises/assignments comprising questions/problems

Sr No	List of Laboratory Exercises (Any Six)
1	Preparation of a Process sheet of a simple turned/milled component
2	Numerical example on Johnson's Algorithm
3	An example on network crashing
4	Preparation of a Gantt Chart
5	A real life example on ABC analysis
6	An example on MRP for planned released orders
7	An example on line balancing
8	Preparation of organization charts with functional relationship for any SME.

Project Based Learning may be incorporated by judiciously reducing number of laboratory exercises

The distribution of marks for term work shall be as follows:

- Lab work/assignments/exercise : **20** marks
- Attendance : **05** marks

Practical/Oral examination

1. Each student will be given a small task based on laboratory excercises, which will be assessed by pair of examiners during the oral examination.
2. Distribution of marks for practical-oral examination shall be as follows:
 Excercise: 15 marks
 Oral: 10 marks
3. Evaluation of practical/oral examination to be done based on the performance of design task
4. Students work along with evaluation report to be preserved till the next examination