UNIVERSITY OF MUMBAI
SCHEME OF INSTRU

CTION AND EVALUATION (R2007)
(with effect from the academic year 2010-2011)
COURSE: B.E. (MECHANICAL ENGINEERING)

SEMESTER: VII

Sr. No	Subjects	No. of periods of 1Hour			Duration of Theory Paper in Hours	Marks				
		Lecture	Practical	Tutorial		Theory Paper	Term Work	Practical	Oral	Total
1	Machine Design– II	4	2	--	4	100	25	--	25	150
2	CAD/CAM/CIM*	4	2	--	4+2PE	100	25	25	--	150
3	Refrigeration and Air Conditioning	4	2	--	3	100	25	--	25	150
4	Manufacturing Planning and Control	4	--	2	3	100	25	--	25	150
5	Elective - I	4	2	--	3	100	25	--	25	150
6	Project	--	4	--	--	--	50	--	--	050
	TOTAL	**20**	**12**	**2**	**--**	**500**	**175**	**25**	**100**	**800**

*Common with Automobile engineering.
(PE) - Practical Examination

COURSE: B.E. (MECHANICAL ENGINEERING)

SEMESTER: VIII

Sr. No	Subjects	No. of periods of 1Hour			Duration of Theory Paper in Hours	Marks				
		Lecture	Practical	Tutorial		Theory Paper	Term Work	Practical	Oral	Total
1	Automobile Engineering	4	2	--	3	100	25	--	--	125
2	Finite Element Analysis*	4	2	--	4	100	25	--	25	150
3	Industrial Engineering and Enterprise Resource Planning	4	--	2	3	100	25	--	--	125
4	Elective – II	4	2	--	3 #	100	25	--	25	150
5	Project	--	8	--	--	--	100	--	50	150
	TOTAL	**16**	**14**	**2**	**--**	**400**	**200**	**--**	**100**	**700**

*Common with Automobile engineering. # Theory paper duration for Elective Mechanical System Design consists of 4Hrs.

(PE) - Practical Examination

ELECTIVE SUBJECTS

Sr.No	Elective I (Semester VII)	Sr.No	Elective II (Semester VIII)
PAIRED ELECTIVES			
P1	Supply Chain Management*	**P1**	Business Process Re engineering*
P2	Cryogenic Engineering*	**P2**	Advanced Refrigeration and Air Conditioning*
P3	Nuclear Technology - I	**P3**	Nuclear Technology - II
OPEN ELECTIVES			
1	Micro Electro Mechanical Systems(MEMS) *	**1**	Introduction to Nanotechnology*
2	Power Plant Engineering	**2**	Non Conventional Energy Sources
3	Operations Research*	**3**	Project management*
4	Information Technology for Management of Enterprises*	**4**	Product Life Cycle Management*
5	Virtual Reality*	**5**	Artificial and Machine Intelligence *
6	Computational Fluid Dynamics*	**6**	Advanced Turbo machinery*
7	Industrial Robotics*	**7**	Mechanical System Design
8	Piping Engineering	**8**	Process Equipment Design
9	Dynamic System Modelling & Analysis		

***** Common with Automobile engineering.

Paired Electives :- If student selects sr. no.P1 as elective –I in semester VII then he/she has to choose sr. no.P1 as elective –II in semester VIII.

Open Electives :- Students can select any one subject as elective-I in semester-VII from sr. no. 1 to 6 and any one subject as elective-II in semester-VIII, from the list.

CLASS: B.E. (Mechanical)			Semester:- **VII**
SUBJECT: **MACHINE DESIGN - II**			
Periods per week. 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	04	100
	Practical	--	--
	Oral Examination	--	25
	Term Work	--	25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	Design of spur, helical, bevels and worm gears. Two stage Gear box consisting of spur and helical gear pair: design approach through system design, gear box housing layout and housing design	12
Module 02	Selection of rolling contact bearings based on constant /Variable Load & speed conditions (includes deep groove ball bearing, cylindrical roller, taper roller and self aligning bearing)	08
Module 03	Design of hydro dynamically lubricated bearings (Self contained) Introduction to hydro Static bearings Selection of Mechanical Seals	06
Module 04	Design of cam and follower mechanisms.	06
Module 05	Design of main components of centrifugal pump - Motor selection, Suction and delivery pipe, Impeller, Impeller shaft, Volute casing. (system design approach)	08
Module 06	Design of Snatch Block assembly including Rope selection, Sheave, Hook, Bearing for hook, cross piece, Axle for sheave and shackle plate	08

TERM WORK:

Term work shall comprise of

1) Exercises on the above topics in the form of design calculations with sketches and or drawings.
2) Design and detailed assembly drawing on **FULL** imperial drawing sheets of Min. **two** design problem, from the module 1, 4, 5 and 6
3) Course project*
4) Class Test based on above syllabus.

* **Course Projects-** There will be a course project where the students will be able to apply and integrate the knowledge gained during the course. The projects will be developed by teams of Two to Four students and will consist of design of any system having min. 5 to 6 components.

Class Assignments & Drawing Sheets : 10 Marks
Course Projects : 05 Marks

Class test	:	10Marks
Total	:	25 Marks

NOTE:
Use of standard design data books like PSG Data Book , Design Data by Mahadevan is permitted at the examination and shall be supplied by the institute.

Oral Examination:
Oral examination will be on maximum portion of the syllabus.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

TEXT BOOKS:

Machine Design Exercises	- S.N. Trikha, *Khanna Publications, Delhi*
Design of machine elements	- V. B. Bhandari *Tata McGraw Hill Pub.*
Machine Design - An Integrated Approach	- Robert L. Norton - *Pearson Education Asia.*
Mechanical Engineering Design	- J. E. Shigley - *McGraw Hill*
Machine Design Exercises	- S.N. Trikha, *Khanna Publications, Delhi*
Recommended Data Books	- PSG, K. Mahadevan

REFERENCES:

Gear Design Handbook	- Gitin Maitra
Material handling equipments	- N. Rudenko , *Peace Publication*
Material handling equipments	- Alexandrov, *MIR Publication*
Machine Design	- Reshetov - *Mir Publication*
Machine Design	- Patel, Pandya, Sikh Vol – I & II, *C. Jamnadas & Co. Educational & Law Publishers*
Design of Machine Elements	- V.M. Faires.
Design of Machine Elements	- Spotts.
Pumps	- Sahu

CLASS: BE(Mechanical)			Semester:-VII
SUBJECT: **CAD/CAM/CIM**			
Periods per week 1Period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	4	100
	Practical	2 (PE)	25
	Oral Examination		--
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**INTRODUCTION & ELEMENTS OF INTERACTIVE COMPUTER GRAPHICS** The design process, the role of modeling & communication, modeling using CAD, Product life cycle & CAD/ CAM, Concurrent engineering in Product design & development, Collaborative Engineering, computers for design Process, CAD System Architecture. The design workstation & its functions, Operator input devices (Mouse, keyboard, tracker ball & Joy Stick etc.), Output devices (Printers & Plotters), two dimensional computer graphics, vector generation, the windowing transformation, three dimensional Computer graphics, viewing transformation, Homogeneous coordinates, Perspective projection, Visual realism, Hidden line removal & hidden surface removal algorithm, light & shade ray tracing.	08
Module 02	**TECHNIQUES FOR GEOMETRIC MODELING** Graphic standards, 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.	06
Module 03	**TRANSFORMATION, MAINPULATION & DATA STORAGE** 2D & 3D Transformations (Translation, Rotation, & Scaling & Magnification), Concatenations, Matrix representation, Problems & object oriented programming on Transformations. Object transformation, mirror transformation, Data Structures for interactive modeling, Bill of materials from attribute data, The use of Object Orientation & associatively, Engineering data management system, relational data base for design, object Oriental database, Structured Query language, Design information Systems. Artificial Intelligence in Design & Manufacturing, Representation of Knowledge, and Knowledge base Engineering.	08

Module 04	**NC & CNC TECHNOLOGY** Introduction, basic components of NC system, NC Procedure, NC Coordinate Systems, & NC motion control systems, Applications, Advantages & Disadvantages of NC machines. Punched tape in NC, Tape coding & format, Manual Part Programming, Computer Aided Part Programming, Problems with conventional NC, CNC functions & advantages, DNC, adaptive Control, CNC programming concepts, Trends & new developments in NC, Part programmers job, functions of a post processor, NC part programming languages, Elements of a APT language, The Macro Statement in APT, Subroutines, NC programming with interactive graphics. Constructional details of CNC machines, Feed back devices- Velocity & displacement, FMS, Machining Centers and its types, Automated Material Handling & storage Systems like Robots, AGVs and AS/RS etc.	12
Module 05	**Group Technology, CAPP, and CAQC** Introduction to GT, Part Families, parts Classification & Coding, GT Machine cells, Benefits of GT Introduction to Computer Aided Process Planning (CAPP), Retrieval type Process Planning Systems, Generative type Process Planning Systems, Benefits of CAPP, Artificial Intelligence in CAPP, PFA, Similarity coefficient matrix. Introduction to Computer Aided Quality Control (CAQC), Computers in QC, Contact Inspection methods, Non Contact Inspection methods, Computer Aided Testing, Integration of CAQC with CAD/CAM	08
Module 06	**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. Rapid Prototyping, Virtual Prototyping, Design for Manufacturing, Design for Assembly and Dis- Assembly, Reverse Engineering and Data Capture techniques, Green Manufacturing.	07

TERM WORK:

Term work shall consist of class assignments, laboratory assignments, programming for transformations, part programming, part fabrication on CNC trainer, and written test. The distribution of marks for term work shall be as follows:

1. Assignments (at least one on each topic) - (05 Marks)
2. Assignments using 3D Modeling Software's like PRO-E, CATIA, UNIGRAPHICS, SOLID WORKS, IDEAS, HYPER MESH, Programming for Algorithms, transformations - (05 Marks)
3. Part Programming Exercises and machining/fabrication of components (at least two) on CNC machines (Turning and Milling each one) - (05 Marks)
4. Class test - (10 Marks)
5. **Total** **(25 Marks)**

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks

2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Practical Examination:

Practical examination of 2 hours duration based on any one of the followings

1) Programming for Algorithms, transformations
2) Part Programming and machining/fabrication of components (only simulation)
3) 3D Modeling of machine elements using Software's like PRO-E, CATIA, UNIGRAPHICS, SOLID WORKS, IDEAS, HYPER MESH, etc.

Text Books:

1. "CAD/CAM Computer Aided and Manufacturing" by Mikell P. Groover and Emory W. Zimmers, Jr., *Eastern Economy Edition,PHI*
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.*

REFERENCE BOOKS

1. "Computer Integrated Manufacturing Hand Book" by Eric Teicholz, Joel N. Orr, *McGraw Hill International Editions*

CLASS:BE(Mechanical)			Semester:-VII
SUBJECT: **REFRIGERATION AND AIR CONDITIONING**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	---	---
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	1) Introduction to Refrigeration Carnot refrigerator, Carnot heat pump, Co-efficient of Performance, unit of refrigeration. 2) Aircraft Air refrigeration systems 2.1 Need for aircraft air-refrigeration 2.2 Simple air-cooling system 2.3 Bootstrap air cooling system 2.4 Reduced ambient air-cooling system 2.5 Regenerative air cooling system Comparison of above aircraft, air refrigeration systems	7
Module 02	3) Vapor Compression Refrigeration System 3.1 Simple vapor compression cycle. Effect of liquid sub cooling and suction vapor super heating. Liquid vapor heat exchanger (LVHE). Actual VCR cycle. 3.2Two stage VCR cycle. Water intercooler, Flash chamber, Multievaporators. 3.3 Refrigerants- Desirable properties of refrigerants. Designation system for refrigerants. Thermodynamic, Chemical and Physical properties. Secondary refrigerants. ODP and GWP. 3.4 Types of evaporators, condensers, expansion devices and Compressors. Defrosting.	9
Module 03	4 Vapor Absorption Refrigeration. 4.1 Importance of VAR system. 4.2 Amonia-water VAR system. Enthalpy-Concentration chart. Analysis of the system 4.3 Lithium Bromide – Water VAR system. Single and double effect. Electrolux refrigeration system	8

Module 04	5. Psychrometry 5.1 Psychrometric properties, chart and processes. Bypass factor, Apparatus dew point temperature. 5.2 Cooling tower- Types of cooling towers, tower approach, tower range, tower efficiency, tower losses, tower maintenance.	8
Module 05	6 Air-Conditioning 6.1 Adiabatic mixing of two air streams, RSHF, GSHF, ERSHF, Room apparatus dew point and coil apparatus dew point. Design of winter and summer air-conditioning systems. 6.2 Human Comfort- Effective temperature, Comfort chart, Comfort zone, air filters.	8
Module 06	7 Duct Design- Friction chart for circular ducts. Equivalent diameter of a circular duct for rectangular ducts. Static pressure regain and equal pressure drop methods of duct design. Fans and blowers. 8 Controls – Thermostat, LP/HP cutoff, Thermopiles, hygrometer, Interlocking control. 9 Applications- study of commercial ice making plant, house hold refrigerator, manufacturing of dry ice, window air conditioner, Liquefaction of gases (cryogenics), thermoelectric refrigeration. Deep sea water air-conditioning.	8

List of Experiments:

1) Assignments based on above syllabus (At least 10 numerical problems)

2) Experiments to find COP for equipments like water cooler, Window air conditioner, etc

3) Experiments involving the study of humidification dehumidification, heating and cooling. Mixing of two air streams.

4) Visit report- Cold storage plant / ice plant or air-conditioning plant.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of syllabus.

Term Work:

Term work shall consist of experiments, assignments (at least one on each module) and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments/visit report): (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: …… (25) Marks.

Text Books:

1) Refrigeration and air-conditioning – C P Arora, *Tata McGraw Hill Publication*
2) Principles of refrigeration – R J Dossat, *Willey Eastern Publication*
3) Refrigeration and air-conditioning – W F Stoker and J W Jones, *Tata McGraw Hill Publication*
4) Modern Air-conditioning practice – C P Arora, *Tata McGraw Hill Publication*

References:

1) Refrigeration and air-conditioning- Manohar Prasad, *New Age Int (P) Ltd.*
2) Basic Refrigeration and air-conditioning- P.Ananthanarayana, Tata Mcgraw

CLASS: BE (Mechanical)		Semester:-VII	
SUBJECT: **MANUFACTURING PLANNING AND CONTROL**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	--	
	Tutorial	02	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	---	---
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**Manufacturing Planning and control System:** Manufacturing – transformation process, Manufacturing as competitive advantage. Manufacturing system – components and types. Types of products. MPC system overview objectives and functions such as planning routing, scheduling, dispatching and follow up. **Forecasting:** Need for forecasting, Types of forecast. Extrapolative methods- Moving average method, Exponential smoothing method, Forecast errors, Linear trend model. Causal methods- Simple regression analysis.	8
Module 02	**Planning Function**: Capacity planning and aggregate planning. Master production schedule, Shop floor Control.	6
Module 03	**Planning for Material requirements:** MRP and MRP II, Concept of JIT. Inventory control systems, Economic Order Quantity. Buffer stocks. Purchase and Production type of inventory. Quantity discount.	9
Module 04	**Scheduling & Sequencing**: Scheduling concept, Scheduling of processes, Gantt chart, job shop scheduling, - Comparison of various methods, Sequencing of tasks using, Johnson's rule. **Project management**: Concepts of project planning, monitoring and control, Project management through network analysis, CPM & PERT, Cost analysis and crashing.	9
Module 05	**Advanced concepts in production planning I** : Mathematical programming approaches- Linear programming problem, Formulation, Simplex method for maximization and minimization, concept of duality.	8
Module 06	**Advanced concepts in production planning II** : Assignment model, Transportation model. **Simulation:** Need for simulation, Monte Carlo technique.	8

TERM WORK:

The Term work shall comprise of at least six assignments (Problems and Case Studies) covering different topics of the syllabus, One Seminar Presentation Report and One Test.
The distribution of marks for term work shall be as follows:

- Laboratory work (Assignments/Case studies/seminar): … (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: ……. (25) Marks.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Text Book:

1. Manufacturing Planning & Control Systems by Thomas E. Vollman. William L. Berry and others. Galgotia Publications
2. Production and Operations Mnagement by S. N. Chary - T. M. H. Publishing Company.
3. Modernization of Materials Management by L. C. Jhamb - Everest Publishing House.
4. Operation Research by Hamdy H. Taha, *Pearson/Prentice Hall*
5. Operation Research by Wayne Winston, *Cengage Learning*
6. Operation Research by Shah, Ravi, Hardik Soni, *PHI Learning*
7. Operation Research by Panneerselvam, *PHI Learning*
8. Production Operation Research by Adam Ebert, *PHI Learning*
9. Manufacturing Process Planning and System Engineering by Anand Bewoor, Dreamtech Press.

Reference Books:

1) Modern production / Operations management by Elwood S. Buffa & Rakesh K. Sarin, *Wiley*
2) Industrial and Production management by Martand Telsang, *S.Chand*
3) Manufacturing, planning and control Systems by Thomos Vollman , William Berry and others, *Tata Mc-Grow Hill.*
4) Operation Research by J K Sharma, *Macmillan*
5) Production Planning and Inventory Control by S.L.Narasimhan and other. *Prentice Hall*

CLASS: BE(Mechanical)			Semester:-VII
SUBJECT: **Supply Chain Management (Elective I)**			
Periods per week. 1Period of 60 min.	Lecture	4	
	Practical	2	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical	-	-
	Oral Examination	-	25
	Term Work	-	25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**1. INTRODUCTION TO SUPPLY CHAIN MANAGEMENT**: Current Business Scenario, Value Matrix Analysis, Evolution of SCM Function, Theme and Pillars of SCM System, How Supply chain works? Participants in the Supply Chain, Supply chain drivers, Supply chain structure	04
Module 02	**2. SUPPLY CHAIN OPERATIONS**: 2.1 Planning and Sourcing Demand forecasting ,Pricing and Promotional Impacts on demand, CPFR Concepts, CODP Concepts, Consensus Forecasting, Demand and Pricing Optimization 2.2 Making and Delivering Product Design, Production Scheduling, Facility Management, Order Management, Delivery Scheduling, Distribution network design, channels of Distribution, Plant and warehouse location.	12
Module 03	**3. MATERIALS MANAGEMENT IN SUPPLY CHAIN** Scope, importance, classification of materials, Procurement, Purchasing policies, vendor development and evaluation, Inventory control systems of stock replenishment, Cost elements New Supply Planning Paradigms, VMI, CMI,Green Channel supply, KM Model of Supplier Partnership, Multi-tier Supplier Partnerships Use of computers for materials function.	08
Module 04	**4. LOGISTICS** 4.1 Logistics Evolution, 8 wings of Logistics, Distribution Network Systems, Warehousing and Inventory Cross-Docs, Multi-Modal Optimization, Inbound and Outbound handling, Containerization, TPL, FPL, MPL Partnering, Reverse Logistics 4.2 Transportation: Individual Freight and passenger modes, intermodal transportation and third party transportation services, economic social, and political roles of transportation, demand, cost and service characteristics of different transport services, carrier selection and evaluation methods, contracting for transportation services, freight rate structure, Private fleet management, Claim management, International transportation, Ocean carrier management, port administration and	10

	regulation, costing and pricing issues of international transportation, logistics, cost transport mode choice, Dispatch decisions, routing decisions, routing Models, packaging to suit mode of Transport	
Module 05	**5. SUPPLY CHAIN COORDINATION AND USE OF TECHNOLOGY** The "Bullwhip" Effect, Supply Chain Coordination factors, Collaborative Planning, Forecasting, and Replenishment, supported information systems, E-Business and Supply Chain Integration, SCM systems Vendors, Types of Applications, Optimization Modeling, E-Business and Systems Integrations from ERP to SCM, KM, APS Systems, Further integration to CRM	06
Module 06	**6.1 MEASURING PERFORMANCE: SUPPLY CHAIN METRICS** Market Performance Categories, Framework for Performance Measurement,, Internal Efficiency Metrics, Demand Flexibility Metrics, Product Development Metrics, Benchmarking and SCM SCORE modeling **6.2 TOTAL DISTRIBUTION COST ANALYSIS**	06

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

Case Study /Course Project: Report of 10 - 15 pages on any topic from syllabus

Term work shall consist of minimum 06 assignments and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (course project / assignments): …… … (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: …… (25) Marks.

Text Books:

1. "Supply Chain Management: Concepts and Cases", Altekar Rahul V., *Prentice Hall of India, 2005*
2. Materials Management and purchasing, Ammer DS Taraporewala
3. "Modeling the Supply Chain", Jeremy F. Shapiro, *Thomson Learning Publication*

References:

1. Supply Chain Management Theories and Practices(Set) by R.P. Mohanty and S. G. Deshmukh , Biztantra Publication.
2. Logistics and Supply Chain Management, Martin Christopher, Richard Irwin
3. Supply Chain Management: Janat Shah, Pearson Education.

4. Principles of Supply Chain Management, Joel Wisner, G. Keong, Cengage Learning

CLASS: BE(Mechanical)			Semester:-VII
SUBJECT: **CRYOGENIC ENGINEERING (ELECTIVE I)**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical		--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	1.1 Introduction to cryogenic systems - development and present state of affairs of cryogenic engineering. 1.2 Low temperature properties of engineering materials, thermal engineering and magnetic properties of cryogenic fluids.	06
Module 02	2. Gas liquefaction systems: system performance parameters, Thermodynamically ideal systems- Joule- Thomson-effect-adiabatic expansion- critical components of liquefaction systems.	08
Module 03	3. Gas separation and purification systems- cryogenic-refrigeration systems, expansion engines refrigeration systems.	10
Module 04	4. Phillips refrigerators, importance of refrigerator effectiveness, Vuilleumier refrigerator, Solvay refrigerator, Gifford-McMahon refrigerator, refrigerators using solids as working media.	08
Module 05	5.1 Measurements systems for low temperatures, temperature, pressure flow rate, and liquid level measurements. 5.2 Cryogenic fluid storage and transfer, system insulations. Importance of vacuum technology in cryogenics.	08
Module 06	Application of cryogenic systems, super conducting devices, space technology, cryogenic in biology and medicine.	08

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

Term work shall consist of minimum **06** assignments at least one on each module, seminar report and written test. The distribution of marks for term work shall be as follows:

- Assignments and seminar report: …….. (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: ……. (25) Marks.

Text Books:

1. Cryogenics Systems - R. Barron *Oxford University Press*
2. Cryo-Cooler, Fundamentals Part-I- G.Walker *Plenum Press New York*
3. Cryo-Cooler, Fundamentals Part-II - G.Walker *Plenum Press New York*

References:

1. Sterling cycle design manual - Martini W. *NASA Report, 1978*

CLASS: BE (Mechanical)		Semester:-VII	
SUBJECT: **Nuclear Technology – I (Elective –I)**			
Periods per week. 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	--	--
	Oral Examination	--	25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 1	**1. Introduction :-** Atomic Structure, Isotopes, Binding Energy, Nuclear energy from fission and fusion reactions, Application areas of nuclear energy- Power plant, Research, Agriculture, medicine and Industry, world scenario on peaceful use of nuclear energy, Share of nuclear energy to overall power production in India, India's relation with world bodies with regard to nuclear material import and technological co-operation, India's program on nuclear energy.	6
Module 02	**2. Radioactivity**:- Radioactive particles, Interaction with matters, radioactive units, measurements.	4

Module 03	**3. Reactor Physics**:- 3.1 Neutron Reactions:- Interaction of neutron with matters, Cross Sections, Fertile, Fissile and Fissionable materials, Fission process, fission process, Chain reactions, Energy releases from fission and fusion processes 3.2 Diffusion and Slowing down of neutron:- Diffusion theories and equations, Elastic and Inelastic scattering, Moderating ratio, Lethargy, Spatial distribution of slowed down neutrons, Age, Migration length, neutron flux – thermal and fast neutrons. 3.3 Reactor Theory:- Criticality condition, Multiplication factors, Four factor formula, Critical size, Non leakage probability, Reflectors, Heterogamous and homogenous reactor systems, Modified four factor formula, Buckling, Thermal Reactor, Fast Reactor, experimental Determination of critical size, Neutron life time, Period, Delayed Neutrons, Reactivity, Temperature coefficient of reactivity, Fission product poison, Burn up power coefficient of reactivity , Void coefficient of reactivity, Effect of isotopic purity of moderator, coolant on reactivity, reactivity units, control of reactivity for reactor operations – Start up from various conditions, power variations, shutdown.	14
Module 4	**4.0 Nuclear Power plant (NPP):** - 4.1 Inland and off land reactors; 4.2 Thermal reactors: Types: BWR, PWR, PHWR, GCR, Advance thermal reactors' Fast Reactors- Concept of breeding, coolant, core composition; Fusion power reactor. 4.3 Off land reactor: space power unit, submarines. 4.4 Conventional System in NPP: Secondary Steam and feed water system, Power generation and Distribution.	8
Module 05	**5.0 Radiation Protection and Radioactive Waste Management:** 5.1 Radiation Protection: Radiation exposure hazard, Dose units, Radiation instrument / equipment, Personal radiation protection 5.2 Radioactive Waste Management: Segregation, Handling, Storage / disposal.	8
Module 06	**6.0 Safety Aspects and Regulation on use of nuclear energy:-** 6.1 Safety Aspects: Instrumentations for reactor control Control of reactivity, Core Cooling, Containment of reactivity. Emergency power supply, dedicated powers supply and Evacuation scheme, Innovative and revolutionary features of power reactors. 6.2 Regulations on the use of Nuclear energy**:** Functions of National regulatory body, Safety requirement, Safety review, Regulatory consents, Inspection and Enforcement.	8

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be based on maximum portion of the syllabus.

Term Work:

Term work shall consist of minimum **06** assignments and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (Assignments): …….. (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: ……. (25) Marks.

Text Books:

1. NPP of Power Plant Engg- A.K. Raja, A.P. Srivastava & M. Dwivedi
2. An Introduction on Nuclear Engineering, A course in Power Plant Engg- Arora & Domkundwar
3. Nuclear Power Plant, Power Plant Engg. (Steam & Nuclear)- P.K. Nag.

Reference Book:

Nuclear Engineering- Glasstone & Sesonske.

CLASS: BE (Mechanical)			Semester:-VII
SUBJECT: **MICRO ELECTRO MECHANICAL SYSTEMS (MEMS) ELECTIVE-I**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical		---
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	Historical Background: Silicon Pressure sensors, Micromachining, Micro Electro Mechanical Systems. Microfabrication and Micromachining: Integrated Circuit Processes. Potential of MEMS in industry.	6
Module 02	Bulk Micromachining : Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA)	7
Module 03	Physical Microsensors: Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor Principles and Examples: Thermal sensors, Electrical Sensors, Mechanical Sensors, Chemical and Biosensors. Microactuators: Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors Microactuator systems: Success Stories, Ink-Jet printer heads, Micro-mirror TV Projector.	8
Module 04	Microstereolithography (MSL) for 3D fabrication, Two photon MSL, Dynamic mask MSL, scanning systems, Optomechatronics system for MSL. Ceramic and Metal Microstereolithography.	9
Module 05	Ceramic and Metal Microstereolithography. Scattering of light by small particles. Effect of particle properties on accuracy and resolution of component in Ceramic and Metal MSL. Monte carlo ray tracing method. Nanolithography.	8
Module 06	Surface Micromaching: One or two sacrificial layer processes, Surface micromachining requirements, Polysilicon surface micromachining, Other compatible materials, Silicon Dioxide, Silicon, Micromotors, Gear trains, Mechanisms. Characterisation of MEMS devices.	8

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

Term work shall comprise of

1) Exercises on the above topics in the form of design and manufacturing strategies for MEMS components.
2) Assignments (at least one on each module)
3) Educational visit to any one MEMS industry. Student shall submit the brief report of visit.
4) Seminar on topic related to MEMS
5) Class Test based on above syllabus.

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

- Laboratory work (Exercise/assignments/visit report/seminar) : (15)Marks.
- Test (at least one): …… (10)Marks.

TOTAL: …… (25)Marks.

Text Books: .

1. MEMS, Vijay Vardan, *Wiley Publication*
2. MEMS and Microsytems Design and Manufacture, Tai- Ran Hsu, *Tata McGraw Hill*
3. MEMS, Nitaigour Mahalik, *Tata McGraw Hill*
4. MEMS and MOEMS Technology and Applications, Rai Chaoudhary, PHI Learning

References:

1. Stephen D. Senturia, Microsystem Design, *Kluwer Academic Publishers,*
2. Marc Madou, Fundamentals of Microfabrication, *CRC Press*
3. Kovacs, Micromachined Transducers Sourcebook, WCB *McGraw-Hill, Boston*
4.M-H. Bao, Elsevier, Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes, New York, 2000.

CLASS: BE (Mechanical)		Semester:-VII	
SUBJECT: **POWER PLANT ENGINERING (ELECTIVE-I)**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	--	--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	1 Economics of the power plant: Load curve, load duration curve, various factors, effect of fluctuating load on operation and design of the plant, methods of meeting fluctuating load. Selection of the generating equipments, load sharing, cost of electrical energy. Tariff methods. Performance and operating characteristics of Power Plants.	
Module 02	2.1 Hydro power plant: Rainfall, runoff and its measurement, hydrograph, flow duration curve, mass curve, and reservoir storage capacity. Classification of the plants- Run-off river plant, storage river plant, pumped storage plant. 2.2 Fluidized bed combustion- regimes of combustion, circulating and pressurized fluidized bed combustion system, Fluidized bed boilers, its important features, classification. Control of Nitrogen oxides.	
Module 03	3.1 Nuclear power plant: Introduction of nuclear engineering- radioactive decay, half life, fission, fusion, nuclear materials. Thermal fission reactors and power plant - PWR, BWR, Liquid metal fast breeder reactors. Reactor control.	
Module 04	4.2 Diesel and Gas turbine power plant: General layout, application of diesel power plant, advantages and disadvantages, component, performance of gas turbine power plant, gas turbine material.	
Module 05	5.1 Combined cycle power generation: Coupled cycle- thermodynamics, combined cycle plant-thermodynamics of GT-ST plant operation; Advantages. Base Load plants. Peak load plants. Co-ordination of different types of power plants.	
Module 06	Environmental impact of power plant: Social and economical issues of the power plants, Greenhouse effect, Acid precipitation- acid rain and acid snow, dry deposition and acid fog, Thermal pollution, air pollution, Radiation from nuclear power plant effluents. Coal storage, Inplant handling of coal, Ash handling systems. Dust collectors. Flue gas, desulfarization methods.	

Educational Visit:
Organize at least one visit to power station. Student shall submit a brief technical report of the visit as a part of term work.

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:
Oral examination will be on maximum portion of the syllabus.

Term Work:
Term work shall consist of minimum **06** assignments at least one on each module, and written test. The distribution of marks for term work shall be as follows:

- Assignments and visit report: …….. (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: …… (25) Marks.

Text Books:

1. Power Plant Engineering - P. K. Nag - *Tata McGraw Hill*
2. Power Plant Technology - M. M. EL - Wakil - *McGraw Hill*
3. Power Plant Engineering - Morse
4. Power Plant Engineering - Domkundwar
5. Power Plant Engineering - P. C. Sharma
6. Power Plant Engineering - Rajput

References:

1. Power Plant Engineering - Gaffert
2. Power Plant Theory & Design - P.J. Potter - Ronald Press
3. Modern Power Plant Engineering - J. Weisman, R. Eekart
4. Power Station Engineering & Economy'- Skrotzki
5. The Elements of Nuclear Power - Bennet, Thomson
6. Standard handbook of Power Plant Engineering - Elliott
7. Modern Power Station Practice: Vol. 1 to 8 - *British Electricity Intl., London - Paragamon Press*

CLASS: BE (Mechanical)			Semester:-VII
SUBJECT **OPERATION RESEARCH (ELECTIVE-I)**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	--	--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**Linear Programming**: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques - Two–phase method, Big-M method – Duality Principle	12
Module 02	**Transportation problem**: Formulation – Optimal solution, unbalanced transportation problem – Degeneracy. Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem. **Sequencing** – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines	7
Module 03	**Replacement**: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement. **Queuing Models**: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals	7
Module 04	**Game Theory**: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games –graphical method.	6
Module 05	**Inventory Models**: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – shortages are not allowed – Stochastic models – demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.	8
Module 06	**Dynamic programming**: Introduction – Bellman's Principle of optimality – Applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem **Simulation**: Definition – Types of simulation models – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages – Simulation Languages	8

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

Term work shall consist of minimum **06** assignments at least one on each module, and written test. The distribution of marks for term work shall be as follows:

- Assignments and visit report: …….. (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: ……. (25) Marks.

Text Books:

1. A.Ravindran , D Phillips, Operations Research :Principal and Practices, Wiley India.
2. Operations Research / S.D.Sharma-Kedarnath.

References:

1. Operations Research /A.M.Natarajan,P.Balasubramani,A. Tamilarasi /Pearson Education
2. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspan and Lawrence Friedman
3. Operations Research / R.Pannerselvam,PHI Publications.
4. Introduction to O.R/Hiller & Libermann (TMH) O.R/Wayne L.Winston/Thomson Brooks/cole
5. Introduction to O.R /Taha//Pearson Education

CLASS: BE(Mechanical)			Semester:-VII
SUBJECT: **Information Technology for Management of Enterprises (ELECTIVE I)**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical		--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**IT in the Organization** **1.1 Organizational Performance: IT support and Applications.** Doing Business In the Digital Economy, Business pressures, organizational performance and responses and IT support, Information Systems and Information Technology, the adaptive , Agile, Real time Enterprise, Information Technology Development and Trends. **1.2 IT Support Systems: Concepts and Management** Information Systems Concepts and Definitions, Classifications and Types of Information Systems, How IT supports People and Organizational Activities, How It supports Supply Chains and Enterprise Systems, Information Systems Infrastructure and Architecture, Emerging Computing Enviornments:SaaS, SOA and more, Managerial issues.	05
Module 02	**IT Infrastructure:** **2.1 Managing Data: Databases and warehousing.** Data Management A Critical success Factor,, File management, Databases and Data Base Management Systems, Creating Databases, Data warehousing, Marketing databases in action, Web Based Data Management Systems, Managerial issues. **2.2 Networks Computing for Collaboration** Discovery Search and Customized Delivery, Communication, Messaging and Collaboration, Social and Ethical issues, Managerial Issues.	07

Module 03	**<u>The Web revolution</u>** **3.1 E Commerce and E Business:** Overview of E Business and E commerce, Major EC Mechanisms, Business to Consumer applications, B2B Applications,Major models of E Business : From E-Government to C2C, e Commerce Support Services : Advertising Payments and order Fulfillment, Ethical and legal issues in E Business, Managerial Issues. **3.2 Wireless Devices and their applications:** Mobile Computing and Commerce: Overview Benefits and Drivers, Mobile applications in Financial Services, Mobile Shopping Advertising and Content providing, Mobile enterprise and Interbusiness Applications, Mobile consumer Services and Entertainment, Location Based Services and Commerce, Pervasive Computing, Managerial Issues.	08
Module 04	**<u>Organizational Applications</u>** **4.1 IT Compliance: Functional Applications and Transaction Processing** Functional informational Systems, transaction processing Information systems, Managing Production / Operations and Logistics, Managing Marketing and Sales Systems, Managing the accounting and Finance Systems, Managing human Resource Systems, Integrating Functional Information Systems, How IT supports compliance, Managerial Issues. **Understanding Enterprise Systems: Supply Chain** Essentials of Enterprise systems and supply chains, supply chain challenges, supply chain opportunities, Business value of Enterprise systems, Enterprise resource planning systems, Business Process Management, Product life cycle Management, Customer Relationship Management, Managerial Issues **4.2 Global and Interorganizational Information Systems:** Interorganizational Activities and order fulfillment, Interorganizational information Systems and Virtual Corporations, Global Information Systems, Facilitating IOS and Global Systems from Demand driven Networks to RFID, Interorganizational Information Integration, Partner relationship Management and collaborative commerce, Managerial issues.	10

Module 05	**Managerial and Decision Support Systems** **5.1 Managing Knowledge** Introduction to Knowledge Management, Organizational Learning and Memory, knowledge management activities, Approaches to Knowledge management, Information Technology in Knowledge Management, knowledge Management Systems implementation, Roles of people in knowledge management, Ensuring Success of KM Efforts, Managerial Issues. **5.2 Corporate Performance Management and Business Intelligence**: A framework of Business Intelligence: concepts and Benefits, Business Analytics: Online analytical processing reporting and querying, Data Text Web mining and Predictive Analytics, Data Visualization, Geographical Information Systems and virtual reality, real time business intelligence, and competitive Intelligence, Business Performance Management Scorecards and Dashboards, Managerial Issues. **5.3 Managerial Decision making and IT support systems** Managers and Decision making, Decision support systems,: for Individuals groups and Enterprise, Intelligent Support Systems : The basics, Expert Systems, Other intelligent systems, Automated Decision Support (ADS), Managerial Issues.	10
Module 06	**Implementing and Managing IT** **6.1 IT: Strategic objectives and Planning** IT Strategic Alignment, Competitive Forces Model, Value Chain Model, Strategic Resources and Capabilities, IT Planning, Interorganizational and international IT planning, Managing the IS department, Managerial issues. **6.2 Economics of IT:** Financial and Economic Trends and the productivity paradox, Evaluating IT investment: Benefits Costs and Issues, Methods for evaluating and justifying IT Investment, IT Economics strategies: Chargeback and Outsourcing, Economic aspects of IT and Web Based Systems, Managerial Issues. **6.3 IT Application Acquisitions and Options** The landscape and framework of IT Application Acquisition, Identifying Justifying and planning IT systems applications, Acquiring IT applications: available options, Outsourcing, application service providers and utility computing, selecting an acquisition approach and other implementation issues, Connecting to Databases, Enterprise systems and Business Partners, Business Process Redesign, Managerial Issues.	08

Theory Examination:

1. 1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:
Oral examination will be on maximum portion of the syllabus.

Term Work:
Term work shall consist of minimum **06** assignments (at least one on each module) and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (experiments/assignments): …….. (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: ……. (25) Marks.

Text Books:
1. Efrain Turban, Dorothy Leidner, Ephrain McLean, James Wetherbe "Information Technology for Management: Transforming Organizations in the Digital Economy", 6th edition. ISBN: 978-8126-51441
2. Management of Information Technology, Carroll Frenzel, Cengage Learning
3. Information Technology for Management- Henry Lucas, Tata McGraw Hill

Reference
1. IT systems Management , Rich Schiesser, Eastern Economy Edition
2. IT Strategy and Management, Sanjiva Shankar Dubey, Prentice Hall

CLASS: BE (Mechanical)			Semester:-VII
SUBJECT: **VIRTUAL REALITY (ELECTIVE I)**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical		--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**1.1 Introduction**: A short history of early virtual reality, early commercial VR Technology, VR becomes an Industry, The five classical components of VR Systems. **1.2 Input Devices: Trackers, Navigations and Gesture Interfaces**. Three Dimensional Position Trackers: Tracker performance parameters, Mechanical trackers, Magnetic trackers, Ultrasonic trackers, Optical Trackers and Hybrid Inertial Trackers Navigation and Manipulation Interfaces: Tracker based Navigation/Manipulation Interfaces, Trackballs, and three Dimensional	06

	Probes Gesture Interfaces: The Pinch Glove, the 5DT Data Glove, the Didjiglove, the Cyberglove	
Module 02	**2. Output Devices: Graphical, Three Dimensional Sound and Haptic Displays.** Graphical Display: The human visual system, personal graphics displays, large volume displays. Sound displays: the human auditory system, the convolvotron, Speaker based three dimentional sound. Haptic Feedback: The human haptic system, Tactile Feedback Interfaces, Force Feedback Interfaces.	08
Module 03	**3. Computing Architectures for Virtual Reality:** The Rendering Pipeline: The graphical rendering pipeline, The haptics rendering pipeline. PC Graphics Architectures: Pc Graphics Accelerators, Graphics Benchmarks. Work Station Based Architectures: the Sun Blade 1000 Architecture, The SGI Infinite Reality Architecture. Distributed VR Architectures: Multipipeline Synchronization, Colocated rendering Pipelines, Distributed Virtual Environments.	08
Module 04	**4. Modeling:** Geometric Modeling: Virtual Object Shape, Object Visual Appearance. Kinematics Modeling: Homogeneous Transformation Matrices, Object Position, Transformation Invariants, Object Hierarchies, viewing the three dimensional words. Physical Modeling: Collision Detection, Surface Deformation, Force Computation, Force Smoothing and Mapping, Haptic Texturing. Behavior Modeling and Model Management: Level of Detail Management, Cell Segmentation.	08
Module 05	**5.1 Virtual Reality Programming:** Toolkits and Scene Graphs. World Toolkit: Model Geometry and Appearance, The WTK Scene Graph, Sensors and Action Functions, WTK Networking, JAVA 3D: Model Geometry and Appearance, Java 3D Scene graph, Sensors and Behaviors, Java 3D Networking, WTK and Java 3D Performance Comparison. General Haptics Open Software Toolkit: GHOST Integration with the Graphics Pipeline, The GHOST Haptic Scene Graph, Collision Detection and response, Graphics and PHANToM Calibration. **5.2 Human Factors in Virtual Reality:** Methodology and Terminology: Data Collection and Analysis, Usability Engineering Methodology. User Performance Studies: Test bed Evaluation of universal VR Tasks, Influence of System Responsiveness on User Performance, Influence of Feedback Multimodality.	10

Module 06	**6.1 Traditional Virtual Reality Applications:** Medical Application of VR: Virtual Anatomy, Triage and Diagnostic, Surgery and Rehabilitation. Education, Arts and Entertainment: VR in Education, VR and the Arts, Entertainment Application of VR. Military VR Application: Army use of VR, VR Application in Navy, Air Force use of VR. **6.2 Emerging Application of VR:** VR Application and Manufacturing: Virtual Prototyping, other VR Application in Manufacturing, Application of VR in Robotics: Robot Programming, Robot Tele operation. Information Visualization: Oil Exploration and Well Management, Volumetric Data Visualization.	08

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

Term work shall consist of minimum **06** assignments (at least one on each module) and written test. The distribution of marks for term work shall be as follows:

- Laboratory work (assignments): …….. (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: …… (25) Marks.

References:

1. Grigore Burdea, Philippe Coiffet, " Virtual Reality Technology" 2nd edition. Wiley India
2. John vince, "Virtual Reality Systems" Pearson Education Asia
3. Understanding Virtual Reality , Sherman,Elsever.

CLASS: BE (Mechanical)			Semester:- VII
SUBJECT: **COMPUTATIONAL FLUID DYNAMICS**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	3	100
	Practical		--
	Oral Examination		25
	Term Work		25

	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**1. Introduction** 1.1 What is CFD 1.2 Scope and Application of CFD 1.3 Methods of Predictions like Experimental, Theoretical 1.4 Working of Commercial CFD Softwares 1.5 Solution methodology-Preprocessing, Solver, Post processing	6
Module 02	**2. Mathematical description of Physical Phenomenon** 2.1 Governing Differential Equations 2.1.1 Meaning of Differential equation 2.1.2 The Continuity Equation 2.1.3 A Momentum equation 2.1.4 The Energy Equation 2.1.5 The General Differential Equation 2.2 Boundary Conditions 2.2.1 Initial and Boundary Conditions 2.2.2 Initial and Boundary Value problems	10
Module 03	**3. Grid Generation and Discretization Methods** 3.1 Structured and unstructured Grids 3.1.1 O-type, H-type, C-type of Structured Grid Generation 3.1.2 Mesh Adaptation 3.2 The Nature of Numerical Methods 3.2.1 The Discritization Concept 3.2.2 The Structure of the Discritization Equation 3.3 Methods of Deriving the Discretization Equations 3.3.1 Taylor-Series Formulation 3.3.2 Variational Formulation 3.3.3 Method of Weighted Residuals 3.3.4 Control Volume Formulation 3.4 Methods for finding the Solution of Discretized Equations	12
Module 04	**4 Heat Conduction** 4.1 Steady One-dimensional Conduction 4.2 Unsteady One-dimensional Conduction 4.3 Two and Three-dimensional Situations 4.4 Over relaxation and Under relaxation	6
Module 05	**5. Convection and Diffusion** 5.1 Steady One-dimensional and Two Dimensional Convection-Diffusion 5.2 Unsteady One-dimensional Convection-Diffusion 5.3 Unsteady Two-dimensional Convection-Diffusion 5.4 Solution of Steady heat Conduction by FEM	6

Module 06	**6. Incompressible Fluid Flow** 6.1 Governing Equations, 6.2 Stream Function-Vorticity Method 6.3 Determination of Pressure for Viscous Flow 6.4 The SIMPLE, SIMPLER Algorithm 6.5 Introduction to Turbulence Modeling 6.5.1 Basic Theories of Turbulence 6.5.2 The Time-Averaged Equations for Turbulent Flow	8

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

Term work shall consist of minimum **06** assignments/tutorials and written test. The distribution of marks for term work shall be as follows:

- Tutorials/assignments: ……. (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: ……. (25) Marks.

Text Books:

1. Versteeg.H.K. , Malalasekera.W. : " An introduction to computational fluid dynamics- The finite volume method", Prentice Hall

2. Anderson, D.A.,Tannehill, I.I., and Pletcher, R.H., Computational Fluid Mechanics and Heat Transfer,Hemishphere Publishing Corporation, New York, USA, 1984.

3. Niyogi.P.,Laha M.K., Chakrabarty S.K.: " Introduction to Computational Fluid Dynamics". Pearson Education, India.

References:

1. Muralidhar, K.,and Sundararajan,T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House ,New Delhi1995.
2. Ghoshdasdidar, P.S.,"Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.

3. Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation
4. Taylor, C and Hughes J.B.,Finite Element Programming of the Navier Stock Equation, Pineridge Press Ltd.,U.K.1981.
5. Fletcher, C.A.J.,"Computational Techniques for Fluid Dynamics 1" Fundamental and General Techniques, Springer-Verlag,1987.
6. Flectcher, C.A.J., "Computational Techniques for Different Flow Categories, Springer-Verlage
7. Bose,T.K.,"Numerical Fluid Dynamics" Narosa Publishing House, 1997..
Schlichting, H.: " Boundary layer theory, McGraw-Hill, New York
8. Pope Stephen: " Turbulence"
9. Computational Fluid Dynamics, A practical approach tu et al ,ELSEVER.

CLASS: BE (Mechanical)			Semester:-VII
SUBJECT: **INDUSTRIAL ROBOTICS (ELECTIVE I)**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	--	--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**1.1 INTRODUCTION:** Automation & robotics, Robotic System & Anatomy Classification, Future Prospects **1.2 DRIVES:** Control Loops, Basic Control System Concepts & Models, Control System Analysis, Robot Activation & Feedback Components, Position & Velocity Sensors, Actuators , Power Transmission Systems. **1.3 ROBOT & ITS PERIPHERALS:** End Effecters - types, Mechanical & other grippers, Tool as end effecter **1.4 SENSORS:** Sensors in Robotics, Tactile Sensors, Proximity & Range Sensors, Sensor Based Systems, Uses Vision Systems - Equipment	8
Module 02	**2 MACHINE VISION:** Introduction, Low level & High level vision, Sensing & Digitising, Image processing & analysis, Segmentation, Edge detection, Object description & recognition, Interpretation, Applications	8
Module 03	**3 PROGRAMMING FOR ROBOTS:** Methods, Robot programme as a path in space, Motion interpolation, level & task level languages, Robot languages; Programming in suitable languages Characteristics of robot.	8
Module 04	**4 ROBOT KINEMATICS:** Forward, Reverse - & Homogeneous Transformations, Manipulator Path Control, Robot Dynamics.	7
Module 05	**5 ROOT INTELLGENCE & TASK PLANNING:** Introduction, State space search, Problem reduction, Use of predictive logic, Means -Ends Analysis, Problem solving, Robot learning,- Robot task planning.	9
Module 06	**6.1 ROBOTIC APPLICATION IN MANUFACTURING:** Material transfer, Machine loading & unloading, Processing operations, Assembly & Inspectors, Robotic Cell Design & Control. **6.2 SOCIAL ISSUES & ECONOMICS OF ROBOTICS**	8

Theory Examination:

1. Question paper will comprise of total seven question, each of 20 Marks
2. Question one will be compulsory and based on maximum part of syllabus.
3. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

Term work shall consist of minimum **06** assignments at least one on each module, programming of robots and written test.

- Laboratory work (assignments, programming of robots): (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: ……. (25) Marks.

References:

1. Robotics for Engineers - Yorem Koren
2. Robotics in Practice - J. F. Engelberger
3. Computer Integrated Manufacturing Technology and Systems - Ulrich rembolds, Christial Blume .
4. Computer Aided Design in Mechanical Engineering - Ramamurthy
5. Robot Dynamics and Control by Mark Spong, Wiley India
6. Robotics - John Craig
7. Robot manipulators: mathematics, Programming and Control - Paul r p
8. Industrial Robotics - Groover and Simmers
9. Measurement systems - Ernest deoblin
10. Mechanical Measurements - Beckwith and Lewisbuck
11. Modern control Engineering - K. Ogata ,PHI
12. Automatic -Control- Systems - Benjamin Kuo, Wiley India
13. Robotic Engineering An Integrated approach - Richard D. KIafter and et. al. PHI
14. Intelligent Robotic Systems - Spyros G. Tzafestas

CLASS: BE (Mechanical)			Semester:-VII
SUBJECT : **PIPING ENGINEERING (ELECTIVE-I)**			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	02	
	Tutorial	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	--	--
	Oral Examination		25
	Term Work		25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**Introduction to Piping** Introduction to phases of plant design**,** Role of Piping within project plan. Design Philosophy, Process data sheets, Process flow diagram, Piping & Instrumentation diagrams, and Equipment layout. Interdisciplinary inputs/coordination.	8
Module 02	**Piping fundamentals** Piping elements (pipes, fittings, flanges , gasket ,bolting ,Valves) ,,Pipe schedule, Pipe thickness calculations, pipe fittings (bends, elbow ,Tees , Reducers, Stub ends, cross), Special pipe fittings, expansion joints, types of flanges, pressure temperature rating for flanges, Pipe hydraulics & Sizing.	10
Module 03	**Piping Codes & Standards** American Standards, Indian standards, British Standards for Piping Engineering. Selection of Design code. Unified numbering system (UNS). **Piping materials** : ASME ,ASTM , IS , DIN materials for piping components such as pipe , fittings , flanges ,bolting , supports ,expansion joints, valves etc. Selection of materials.	8
Module 04	**Piping Drawing** Piping symbols, orthographic (Plan & Elevation) drawings, Isometric Drawings. **Plot Plan**, **Equipment Layout, & Piping GA Drawings**. Plot Plan Development & Requirements(General guidelines) Equipment Layout Terminology, Control Point & Battery Limits. Preparation of Equipment Layout. Piping GA Drawing Requirements and Layout Procedure. Pump GA Drawing and Layout Consideration. Tank & Vessel Layout Consideration. GA - Print Reading Exercise	10
Module 05	**Piping supports** Fixed supports like Rest , Line guide, Line stop ,Hold down, Rigid strut etc., Flexible supports like variable spring support, constant spring support, Snubber etc.	4
Module 06	**Piping Stress Analysis :** Need of Stress Analysis, Procedure to carry out stress analysis,Loads on the piping system(such as sustained , thermal, occassional, hydro-test loads, water hammer, relief valve outlet)**,** Allowable stress**,** Flexibility analysis, thermal load calculations, critical line list preparation , Steps involve in stress analysis of piping system, Pipe support	8

	span calculations, expansion loop & expansion joints ,software's used for stress analysis of piping system .	

Theory Examination:

5. Question paper will comprise of total seven question, each of 20 Marks
6. Question one will be compulsory and based on maximum part of syllabus.
7. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

Oral Examination:

Oral examination will be on maximum portion of the syllabus.

Term Work:

ASSIGNMENTS

1 Introduction to Piping .
2 Piping fundamentals .
3 Piping Codes & Standards.
4 Piping materials.
5 Piping supports
6 Piping Stress Analysis.
7 Introduction to Modeling software's (PDMS, PDS etc.) & Stress analysis (CAESAR II) software's.

PRACTICALS

1 Draw Piping Symbols.
2 Draw General Arrangement for Plant Layout.
3. Pipe rack width calculation.
4. Draw Isometric drawing of any 5 piping systems

- Laboratory work (assignments, programming of robots): (15) Marks.
- Test (at least one): …… (10) Marks.

TOTAL: …… (25) Marks.

References:

1. Mohinder L. Nayyar , Piping Handbook , McGraw-Hill Publication
2. Macetta , John. "Piping Design Handbook", M. Dekker , 1992
3. ASME code for Process Piping ,ASME B31.1
4. ASME code for Process Piping , ASME B31.3
5. ASME B16.5 , Pipe ,Flanges & Flange Fittings
6. An International Code 2007 ASME Boiler & Pressure Vessel Code, Rules For Construction of Pressure Vessels , Section II A,B,C&D.

CLASS: BE. (Mechanical)			Semester:- **VII**
SUBJECT: DYNAMIC SYSTEM MODELLING & ANALYSIS (ELECTIVE I)			
Periods per week 1Period of 60 min.	Lecture	04	
	Practical	--	
	Tutorial	02	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical	--	
	Oral Examination	--	25
	Term Work	--	25
	TOTAL		**150**

Sr. No.	Details	Hrs.
Module 01	**Introduction to dynamic systems.** **Mathematical Modeling of Dynamic Systems:--Using Newton's law of cooling, Torricelli's law, Radiocarbon dating, Radioactive Decay, Skydiver, Mixing problem, Kirchhoff's law, Terminal velocity, Motion of chain on pulley etc.** **Analysis and Design of Dynamic Systems.**	**08**
Module 02	**Complex Analysis: Complex numbers in Rectangular &Polar forms.** **Complex variables and Complex function.** **Differential Equations: Linear Differential Equations with constant Coefficients.** **Laplace Transform: Laplace transformation of Derivatives & Integrals.** **Inverse Laplace Transformation, Shift on t-axis & S-axis** **Applications of Laplace Transform: System Response- First order system / Second order systems. Initial Value Theorems, Final Value Theorems.**	**08**
Module 03	**Matrix Analysis: Vectors& Matrices. Determinants, Inverse & Rank of matrix, Eigen values & Eigen vectors, Partitioning of Matrices, Matrix Transformation & Diagonalization.**	**04**

Module 04	**. System Model Representation** **Configuration Form** **State Space Representation** **Input- Output Equation.** **State Space Representation From I / O Equation & from Transfer function & Transfer Function from State Space.**	**08**
Module 05	**Mechanical System: Translation system, Rotational system ,Geared system.** **Electromechanical system: Elemental Relations of Electromechanical systems. Armature-Controlled DC Motors. Field-Controlled DC Motors.** **Electric Network** **Fluid & Thermal Systems**	**12**
Module 06	**MATLAB Basics: Introduction, Statements of variables, Vectors, MATLAB Functions, Printing and Graphics, Linear Algebra, Matrix Operations, Laplace Transforms.** **MATLAB Tutorial: Single Degree of Freedom Systems, Tow Degree of Freedom Systems, Transient Response Analysis, Response to Initial Condition**	**08**

TERM WORK:
Term work shall comprise of the class assignments and a class test based on above syllabus.

Class Assignments : 15 Marks
Class test : 10 Marks
Total : 25 Marks

TEXT BOOKS:
- DYNAMIC SYSTEMS Modeling and Analysis – Hung V. Vu & Ramin S. Esfandiari. McGRAW-HILL INTERNATIONAL EDITIONS
- System Dynamics – Katsuhiko Ogata PEARSON Education
- Engineering System Dynamics—Rao V. Dukkipati. Narosa Publication
- Control Systems Engineering – Norman S. Nise. WILEY STUDENT EDITION
-

REFERENCES:
SYSTEM DYNAMICS & CONTROL—Eronini Umez- Eronini THOMSON

Theory Examination:
5. Question paper will comprise of total seven question, each of 20 Marks
6. Question one will be compulsory and based on maximum part of syllabus.
7. Remaining questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
8. Only five question need to be solved.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.