Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere – 577 004
Department of Civil Engineering

Course File Check List

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CONSTRUCTION MANAGEMENT AND ENTREPRENEURSHIP

(18CV51)

2020-2021 (ODD SEMESTER)

Name: Smt. ARPITHA D J

Assistant Professor

Department of Civil Engineering

Revised Academic Calendar of VTU, Belagavi for ODD Semester of 2020-21 (Tentative)

	I Sem B. E. / B. Tech. / B. Arch./B.Plan	I sem M.Tech./MBA /MCA/M.Arch.	III, V B. E. /B. Tech./B.Plan/ B.Arch & VII sem BPlan /BArch & IX Sem B. Arch.	VII Sem B. E. /B. Tech	III & V Sem MCA	III Sem MBA	III Sem M. Tech.	III Sem M. Arch.
Commencement of ODD Semester	14.12.2020	Will be announced later	01.09.2020	01.09.2020	01.09.2020	01.09.2020	01.09.2020	01.09.2020
Last Working day of ODD Semester	25.03.2021		16.01.2021	16.01.2021	16.01.2021	16.01.2021	16.01.2021	16.01.2021
Practical Examinations	29.03.2021 Onwards#		21.01.2021 Onwards#	21.01.2021 Onwards#	08.02.2021 Onwards#	--	21.01.2021 Onwards#	--
Theory Examinations	12.04.2021 To 30.04.2021		08.02.2021 To 27.03.2021	08.02.2021 To 27.03.2021	21.01.2021 To 06.02.2021	21.01.2021 To 19.02.2021	28.01.2021 To 13.02.2021	21.01.2021 To 06.02.2021
Internship			---	29.03.2021 To 10.04.2021	---	---	---	---
Internship Viva-Voce			---	---	---	---	15.02.2021 To 22.02.2021	---
Professional training / Organization study			---	---	---	22.02.2021 To 03.04.2021	---	---
Commencement of EVEN Semester	03.05.2021		29.03.2021	12.04.2021	15.02.2021	05.04.2021	23.02.2021	08.02.2021

NOTE:

- VII Semester B. E. / B. Tech. students shall have to undergo Internship as per circular of University VTU/Aca/2019-20/85, dated 12.05.2020.
- I Semester B. E/ B. Tech / B. Arch Students shall compulsorily undergo Induction Program for 01 Weeks.
- The classroom sessions for all the semesters would be in ONLINE mode/blended mode until further orders.
- The Institute needs to function for six days a week with additional hours (Saturday is a full working day).
- The faculty/staff shall be available to undertake any work assigned by the university.
- If any of the above dates are declared to be a holiday then the corresponding event will come into effect on the next working day.
- (#) Notification regarding the Calendar of Events relating to the conduct of University Examinations will be issued by the Registrar (Evaluation) from time to time.
- Academic Calendar may be modified based on guidelines/directions issued in the future by MHRD/UGC/AICTE/State Government.
- Revised Academic Calendar is also applicable for Autonomous Colleges.
- The MBA students are permitted to carry out project work in blended mode (ONLINE/OFFLINE). More emphasis on OFFLINE mode wherever feasible.

04-12-2020.
REGISTRAR

Bapuji Institute of Engineering and Technology, Davangere-577004

CALENDER OF EVENTS - ODD SEMESTER: SEPTEMBER-JANUARY- 2020-21 (Tentative)

PARTICULARS	I sem BE/B Tech	III, V BE/B.Tech	VII sem BE/B.Tech	III & V sem MCA	III sem MBA	III sem M.Tech
Commencement of ODD Sem	14-12-2020	01-09-2020	01-09-2020	01-09-2020	01-09-2020	01-09-2020
Last Working Day	25-03-2021	16-01-2021	16-01-2021	16-01-2021	16-01-2021	16-01-2021
1st CIE Series	------	19-10-2020 To 24-10-2020	19-10-2020 To 24-10-2020	19-10-2020 To 24-10-2020	15-10-2020 To 17-10-2020	19-10-2020 To 24-10-2020
2nd CIE Series	------	07-12-2020 To 09-12-2020	07-12-2020 To 09-12-2020	07-12-2020 To 09-12-2020	26-11-2020 To 28-11-2020	07-12-2020 To 09-12-2020
3rd CIE Series	------	11-01-2021 To 13-01-2021	11-01-2021 To 13-01-2021	11-01-2021 To 13-01-2021	7-01-2021 To 9-01-2021	11-01-2021 To 13-01-2021
Practical Examination	29-03-2021 Onwards #	21-01-2021 Onwards #	21-01-2021 Onwards #	08-02-2021 Onwards #	----	21-01-2021 Onwards #
Theory Examination	12-04-2021 To 30-04-2021	08-02-2021 To 27-03-2021	08-02-2021 To 27-03-2021	21-01-2021 To 06-02-2021	21-01-2021 To 19-02-2021	28-01-2021 To 13-02-2021
Internship	------	------	29-03-2021 To 10-04-2021	----	----	----
Internship Viva-Voce	------	----	----	----	----	15-02-2021 To 22-02-2021
Professional Training/Organization Study	----	----	----	----	22-02-2021 To 03-04-2021	----
Commencement of Even Semester	03-05-2021	29-03-2021	12-04-2021	15-02-2021	05-04-2021	23-02-2021

Notification regarding the calendar of events relating to the conduct of University Examination will be issued by the Registrar (Evaluation) from time to time.

Dean Academic

09/11/20

Principal

Vision of BIET

To be a center of excellence recognized nationally and internationally, in distinctive areas of engineering education and research, based on a culture of innovation and invention.

Mission of BIET

BIET contributes to the growth and development of its students by imparting a broad based engineering education and empowering them to be successful in their chosen field by inculcating in them positive approach, leadership qualities and ethical values

VISION OF THE DEPARTMENT

To train the students to become Civil Engineers with leadership qualities, having ability to take up professional assignments and research with a focus on innovative approaches to cater to the needs of the society.

MISSION OF THE DEPARTMENT

1. To provide quality education through updated curriculum and conducive teaching learning environment for the students to excel in higher studies, competitive examinations and professional career.
2. To impart soft skills, leadership qualities and professional ethics among the graduates to handle the projects independently with confidence.
3. To deal with the contemporary issues and to cater to the socio-economic needs.
4. To build industry-institute interaction and to establish good rapport with alumni.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

***PEO 1: Core Competence*:** Graduates will be able to plan, analyse, design and construct sustainable Civil Engineering Infrastructure.

***PEO 2: Professional Skills*:** Graduates will be professional engineers with a sense of ethics, creativity, leadership, self-confidence and independent thinking to cater to the needs of the society.

***PEO 3: Societal Needs*:** Graduates will be able to contribute effectively for the development of industry and professional bodies.

***PEO 4: Cognitive Intelligence*:** Graduates will be able to take up competitive examinations, higher studies and involve in research and entrepreneurship activities.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Students after the completion of the Program will be able to

1. Apply the fundamental concepts, software and codal provisions in the analysis, design and construction of sustainable civil engineering infrastructure.
2. Inculcate professional and leadership qualities, sense of ethics and confidence related to civil engineering.

Faculty will be able to

3. Contribute to the overall development of civil engineering community through the professional bodies and offer services to the society.

PROGRAM OUTCOMES (POs defined by NBA)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

TIME TABLE

Day / Time	1	2	10.00 - 10.30	3	4	12.30 - 2.00	5	6	7
	8.00 - 9.00	9.00 - 10.00		10.30 - 11.30	11.30 - 12.30		2.00 - 3.00	3 00 - 4 00	4 00 - 5 00
MONDAY			SHORT BREAK	18CU51 'A'		LUNCH BREAK	18CU34 'A'		
TUESDAY		18CU51 'A'			18CU34 'A'				
WEDNESDAY		18CU34 'A'			18CU51 'A'		18CUL58 - A1 ← ADJ + Dr.MNS	→	
THURSDAY							18CUL58 - B2 ← ADJ + RSC	→	
FRIDAY	18CUL37 T 'A'	← 18CUL37 - A3 ADJ + SH		→					
SATURDAY	18CUL37 T 'B'			18CU51 'A'					

Sign. of the Staff

Sign. of the HOD

Entrepreneurship: Evolution of the concept, functions of an entrepreneur, concepts of entrepreneurship, stages in entrepreneurial process, different sources of finance for entrepreneur, central and state level financial institutions.

Micro, Small & Medium Enterprises (MSME): definition, characteristics, objectives, scope, role of MSME in economic development, advantages of MSME, Introduction to different schemes: TECKSOK, KIADB, KSSIDC, DIC, Single Window Agency: SISI, NSIC, SIDBI, KSFC.

Business Planning Process: Business planning process, marketing plan, financial plan, project report and feasibility study, guidelines for preparation of model project report for starting a new venture. Introduction to international entrepreneurship opportunities, entry into international business, exporting, direct foreign investment, venture capital.

Course Outcomes: After studying this course, students will be able to:

1. Prepare a project plan based on requirements and prepare schedule of a project by understanding the activities and their sequence.
2. Understand labour output, equipment efficiency to allocate resources required for an activity / project to achieve desired quality and safety.
3. Analyze the economics of alternatives and evaluate benefits and profits of a construction activity based on monetary value and time value.
4. Establish as an ethical entrepreneur and establish an enterprise utilizing the provisions offered by the federal agencies.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. P C Tripathi and P N Reddy, "Principles of Management", Tata McGraw-Hill Education
2. Chitkara, K.K, "Construction Project Management: Planning Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi.
3. Poornima M. Charantimath , "Entrepreneurship Development and Small Business Enterprise", Dorling Kindersley (India) Pvt. Ltd., Licensees of PearsonEducation
4. Dr. U.K. Shrivastava "Construction Planning and Management", Galgotia publications Pvt. Ltd. New Delhi.
5. Bureau of Indian standards – IS 7272 (Part-1)- 1974 : Recommendations for labour output constant for building works:

Reference Books:

1. Robert L Peurifoy, Clifford J. Schexnayder, AviadShapira, Robert Schmitt, "Construction Planning, Equipment, and Methods (Civil Engineering), McGraw-HillEducation
2. Harold Koontz, Heinz Weihrich, "Essentials of Management: An International, Innovation, and Leadership perspective", T.M.H. Edition, NewDelhi
3. Frank Harris, Ronald McCaffer with Francis Edum-Fotwe, " Modern Construction Management", Wiley-Blackwell
4. Mike Martin, Roland Schinzinger, "Ethics in Engineering", McGraw-HillEducation
5. Chris Hendrickson and Tung Au, "Project Management for Construction - Fundamentals Concepts for Owners, Engineers, Architects and Builders", Prentice Hall,Pitsburgh
6. James L.Riggs, David D. Bedworth , Sabah U. Randhawa " Engineerng Economics" 4

Title & Code	Construction Management and Entrepreneurship (18CV51)
CO	Statement
18CV51.1	**Explain** the construction management, planning and its scheduling by project tools
18CV51.2	**Explain** the concept of resource and material management, and labour productivity
18CV51.3	**Calculate** the productivity of construction equipment
18CV51.4	**Explain** the quality, safety and human values for the effective construction management
18CV51.5	**Explain** the principles of engineering economics by problem solving and decision making concept
18CV51.6	**Explain** entrepreneurship and its role in infrastructural development

Course Title	Construction Management and Entrepreneurship											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
18CV51.1	2	2		1							2	2
18CV51.2	2			1							2	2
18CV51.3	2	2		1							2	2
18CV51.4	2			1		2		2				2
18CV51.5	2	2		1							2	2
18CV51.6	2			1							2	2
Average	2	2		1		2		2			2	2

CO	PSO1	PSO2
18CV51.1	2	2
18CV51.2	2	2
18CV51.3	2	2
18CV51.4	2	2
18CV51.5	2	2
18CV51.6	2	2
Average	2	2

LESSON PLAN

Subject: 18CV51 CTM Subject Code: 18CV51 Class: V A

Period	Date	Topics Planned	Date	Topics Covered	Remarks
L1		Mod-1 Const^n Management characteristics of mgt, Function of Mngt, Importance & purpose	9/9	Mod-1: Const^n Mgt Introduction, funs of Mgt Importance & purpose	
L2		Types of plans, CPF Project organization	12/9	Type of plans, project organization, Its diff plans & CPF	
L3		Management funtions management Styles	14/9	Function of Management styles, construction planning Work breakdown structure	
L4		Construction planning Work break down structure and its Examples.	15/9	& its Examples. Gyeantt Chart, Preparation of network diagram.	
L5		Gyeantt chart, preparation of network diagram	16/9	Event based diagram, Activity based diag. Critical path method.	
L6		Event based diagram Activity based diagram. Critical path method.	19/9	AON, AOA methods problems on PERT problems on CPC.	
L7		AON., AOA methods Problems on PERT.	21/9	Problems on Critical path Q.P problems.	
L8		Problems on PERT with Examples.	22/9	Introduction & Explation on project Mgt tools.	
L9		Problems on Critical path method.	23/9	Network plans & class on how to draw network problems network.	
L10		Introduction & Explination on project Mgt tools.	26/9	Mod:2 Introduction To Resource Mgt. Diff classes of labours	
L11		Mod:2: Resource Management and classes of labour, wages and Statutory Requirements	28/9	Statutory Leg. LPR Productivity factors effecting labour output & productivity	
L12		Labour production Rate/ Productivity, factors effects labour output & productivity	29/9	Construction Equipment and their uses.	
L13		Construction Equipment and their uses.	30/9	Equipments of productivity → Excavator, dozer Compactor grader, dumpers	
L14		Estimation of productivity for Excavator, dozers Compactor	3/10	calculation of productivity on all Equipment (only Exp. with formula)	
L15		Grader, dumpers productivity Calculation.	5/10	Estimation of ownership cost & operating cost	
L16		Estimation of ownership cost and operating cost.	6/10	Selection of Construction and Equipment Sel^n Equipment Mngt Explain	
L17		Selection of Construction Equipment	7/10	Introduction to Material management & function	

LESSON PLAN

Subject: CTM Subject Code: 18CV51 Class: V 'A'

Period	Date	Topics Planned	Date	Topics Covered	Remarks
L_{18}		Basic concept on Equipment Management	10/10	Inventory Mgt and case studies	
L_{19}		Introduction to Material management & its functions	14/10	Mod:3 Const^n qlty proc Inspection, Qlty control & Qlty Assurance.	
L_{20}		Inventry Management and Case Studies.	17/10	Cost of quality Iso-standards.	
L_{21}		Mod:3: Construction Quality processes, Inspection	20/10	Introduction to Concept of total quality mgt.	
L_{22}		Quality control & Quality Assurance, Cost of quality Iso-Standards	21/10	HSE in CT, Importance of Saftey in Const^n a) Excavation b) Explosives	
L_{23}		Introduction to Concept of Total Quality mgnt.	24/10	c) drilling d) blasting e) hot bit works f) Scaffolds/ladder	
L_{24}		HSE in CT, Importance of saftey in constrction, 1) Excavation	27/10	g) formwork & Equipment operation h) Eq. operation i) storage of Materials	
L_{25}		2) explosives 3) drilling and blasting, 4) hot bit works	28/10	Saftey through legislation. Saftey companion & Insurances.	
L_{26}		5) Scaffolds/platforms/ladder 6) formwork & Equipment operations, 7) Storage of Mtr.	2/11	Ethics, Morals, values Integrity, trustworthyness work ethics, readiness	
L_{27}		Saftey through legislation, Saftey companions & Insurances.	3/11	prof. duties, Engg Ethics, rights, confident. & probity	
L_{28}		Ethics: Morals, Values & Ethics, Integrity, trustworthyness, work ethics, readiness	4/11	Conflict of Intrest, Confidentiality gifts & bribes, price fixing, whistle blowing	
L_{29}		Professional duties, & Individual rights, Confidential & Priv. Engg. Ethics	7/11	Mod:4: Introduction to Engg Economy, Micro & Macro Economics.	
L_{30}		Conflict of Intrest, Confidentiality Gifts and bribes, Price fixing, whistle blowing	9/11	Problem solving & decision making, Intrest & time value of money	
L_{31}		Mod:4: Introduction to Engg Economy, Micro & Macro Economics.	10/11	Simple Intrest CI Intrest formulas for Single payment.	
L_{32}		Problem solving & decision making. Intrest and time value of money	11/11	a) SI b) EP c) Uniform gradient Series	
L_{33}		Simple Intrest CI Intrest formula for a) Single payment	17/11	Nomal & Effective Intrest rate Cap. & diff annuities & Cost	
L_{34}		b) Equal payment c) Uniform gradient Series	18/11	Comparision of alternatives a) P.W.M b) AE M c) C & R of Solar Method	

LESSON PLAN

Subject : CTM Subject Code : 18CV51 Class : V A

Period	Date	Topics Planned	Date	Topics Covered	Remarks
L_{35}		Normal & Effective Intrest rate (capitalised) differed annuities & costs.	21/11	Problems on all the methods.	
L_{36}		Comparision of alternatives a) Present worth b) Annual Equivalent Method	23/11	Problem on (QP) All 3 years	
L_{37}		c) Capitalised & Rate of Return method	24/11	Broad down analysis. Minimum cost Analysis	
L_{38}		Problem on a, b, c	25/11	Mod5. Entrepreneurship. Evolution of concept.	
L_{39}		Problemens (q.p) Solved by Intrest factor	28/11	Function of Entrepreneur Concept of Entrepreneur	
L_{40}		Minimum cost Analysis & Break even Analysis.	30/11	State level & financial Institutions, Micro Small & Medium Scale Ind.	
L_{41}		Mod:5 : Entrepreneurship. Evolution of Concept, Function of Entrepreneur	1/12	All Industries Interaction with Schools	Required by student
L_{42}		Concept. of Entrepreneur Concept of finance for Entrepreneurs	2/12	KIADB, KSSIDC DIC (defn, Characteristics obj)	
L_{43}		State level & financial Institutions. Micro, Small and Medium Scale Industries [MSME]	5/12	TECKSOK, SWA SISI, NSIC, SIDBI KSFC.	
L_{44}		KIADB, KSSIDC, DIC [defn, Characteristics, obj]	12/12	Business planning process, Business planning process.	
L_{45}		TECKSOK, SWA → SISI NSIC, SIDBI, KSFC.	14/12	Financial plan, project report & feasibility study Model projects	
L_{46}		Business planning process. Business planning process in Marketing plans	16/12	Introduction to Internal entrepreneurship opportunities	
L_{47}		financial plan, project report & feasibility study Model project - New venture	19/12	Entry into International business	
L_{48}		Introduction to International entrepreneurship opportunities	21/12	Best Ex for the International Business.	
L_{49}		Entry into International business, Exporting direct foreign Investment Venture etc.	22/12	Case Study on. Diff Business plan.	
L_{50}		Case studies and ppt on Business plans.	23/12	Financial plan for a new project	
			26/12 28	Model report of project	

LESSON PLAN

Period	Date	Topics Planned	Date	Topics Covered	Remarks
			28/12	Mod: 4: Exhaustive problem, Soln (95% ppr. problems)	
			29/12	Problems on SI, CI and Seriously	
			30/12	Practical Applications of CT on Industries	(General Discussion)

Text Books :

1. P. C Tripathi & PN. Reddy "Principles of Mgt"
   Chitkara K.K "Const" project Management
2. Dr. U.K Shrivastava "Const" Planning & Mgt",
   Bureau of Is - 7272 (P-1): Labour out put Constant for building works

Reference Books :

1. Robert L. Peurifoy "Const" Planning, Eq. & Methods
2. S.C Sharma - Construction Equipments & its Mgt"
3. .....
4. .....
5. .....

Signature of Faculty

HOD

Class : V Sem 'A' Sec Subject Code : 18CV51

Subject : Construction Management & Entrepreneurship Total No. of Classes :

Sl No.	USN	NAME	DATE	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
1	4BD16CV079	Ramya. H. Naik				24	24	27	10	35
2.	4BD17CV027	Eramma. V				24	24	24	10	34
3.	4BD17CV055	Nandeesh. B. K				28	31	30	10	37
4.	4BD17CV083	Sahana. N. K				28	26	27	10	37
5.	4BD17CV091	Sharath. G. U				28	24	28	10	37
6.	4BD17CV105	Thippeswamy. N. R				24	28	24	10	36
7.	4BD17CV107	Vaesha. S. Mahabi				27	27	27	10	37
8.	4BD17CV113	Vijeth. K. S.				24	28	24	10	36
9.	4BD18CV001	Afreen. M. V				29	29	29	10	39
10.	4BD18CV003	Ambika. Ningappa.				29	28	29	10	39
11.	4BD18CV007	Arfaat Ahmad. H				28	28	28	10	38
12.	4BD18CV009	Ashwini Ningappa.				29	28	29	10	39
13.	4BD18CV011	Basavaraj. V				28	26	28	10	38
14	4BD18CV013	Bhagyashree. H. N				26	28	15	10	34
15	4BD18CV015	Chandana. P. R				26	24	29	10	37
16	4BD18CV021	Dikshitha. R. P				28	28	28	10	38
17	4BD18CV023	Divakar Naik. G. C				28	27	29	10	38
18	4BD18CV025	Geetha. R. G				28	28	28	10	38
19	4BD18CV029	Hrithik. K				28	28	28	10	38
20	4BD18CV031	J. S. Anjan				28	28	28	10	38
21	4BD18CV033	Kiran Gowda N. M				28	28	28	10	38
22	4BD18CV035	Kushal P				24	24	24	10	34
23	4BD18CV037	M. Harish. Kumar				28	28	27	10	38
24	4BD18CV039	Mallikarjun G				25	28	28	10	37
25	4BD18CV041	Manoj. H. M				27	28	26	10	37
26	4BD18CV043	Megha. M. M				28	28	28	10	38
27	4BD18CV045	Mohamed Akram				28	28	28	10	38
28.	4BD18CV049	Mowira. M				28	28	27	10	38
29	4BD18CV051	Nanditha. N. Angadi				22	28	25	10	35
30	4BD18CV053	Naveen. M. Patil				26	26	26	10	36
31	4BD18CV055	Noor Jahan. N. H				28	27	29	10	38
		Initials of Teacher								
		Initials of H.O.D.								
		Initial of Principal								

Class : V 'A' Subject Code : 18CV51

Subject : Construction Management and Entrepreneurship Total No. of Classes :

Sl No.	USN	NAME	DATE	9/01/2020	12/01/2020	14/01/2020	15/01/2020	16/01/2020	19/01/2020	21/01/2020	22/01/2020	23/01/2020	24/01/2020	28/01/2020	29/01/2020	30/01/2020	31/01/2020	5/02/2020	6/02/2020	7/02/2020	10/02/2020	11/02/2020	13/02/2020	14/02/2020	17/02/2020	18/02/2020	19/02/2020	20/02/2020	21/02/2020	24/02/2020	25/02/2020	26/02/2020	27/02/2020	28/02/2020	2/03/2020	3/03/2020	4/03/2020	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
32	4BD18CV057	Prabhudev. H. D		1	2	3	4	5	6	7	8	9	10	A	11	12	13	14	A	15	16	17	18	19	20	21	22	23	24	25	26							28	28	27	28	10	38
33	4BD18CV061	Puttaveerachari. B.L		A	A	1	2	3	4	5	6	7	8	9	10		11	12	13		14				15	16	17	18	19	20	21							28	27	28	28	10	38
34	4BD18CV063	Rahim. Mirza		A	A	A	A	A	1	2	3	4	5	6	7	8	9		10	11	12	13	14	15	16	17	18	19	20	22	A							30	28	28	29	10	39
35	4BD18CV065	Rashmi. G.S		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27							29	28	29	28	10	39
36	4BD18CV067	S. V. Mohammed Sahil		A	1	2	A	A	3	A	A	A	A	A	A	A	A	14	15	A	16	17	18	A	19	A	20	A	21	22	23							28	28	21	26	10	36
37	4BD18CV069	Sahana. K.M		1	2	3	4	5	6	7	A	8	9	10	11	12	13	14	15	16	A	17	18	19	20	21	22	23	24	25	26							28	28	28	28	10	38
38	4BD18CV071	Sanjay. M.S		1	2	3	4	A	A	A	A	A	A	A	A	A	A	5	6	7	8	9	10	11	12	13	A	14	15	17	A							24	28	23	25	10	35
39	4BD18CV073	Sagib Aftab. Pasha. HA		A	1	2	3	4	5	6	7	8	9	A	A	A	A	A	A	10	11	12	13	14	15	16	17	18	19	20	21							29	28	29	28	10	39
40	4BD18CV079	Siddesh. K. P		1	2	3	4	5	6	A	A	A	A	A	A	A	A	A	7	8	A	9	10	11	12	13	14	15	16	17	18							17	28	28	28	10	35
41	4BD18CV081	Spandana. V		A	1	2	3	A	4	5	6	7	8	9	10	11	A	A	12	13	14	A	A	15	A	16	A	17	A	18	19							24	28	28	27	10	37
42	4BD18CV083	Suhasini Angadi		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28							28	28	28	28	10	38
43	4BD18CV085	Sumanth. Rao. M.G		A	A	A	1	2	3	A	A	A	A	A	A	A	A	A	4	5	6	7	8	9	10	11	12	13	14	15	16							28	28	28	28	10	38
44	4BD18CV087	Supriya. T		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28							28	29	29	28	10	39
45	4BD18CV089	Tejashwini. Angadi		1	2	3	4	5	6	7	8	9	10	11	12	13	14	A	15	16	17	18	19	20	21	22	23	24	A	25	26							28	29	27	28	10	39
46	4BD18CV091	Thanmai. S.R		1	A	A	A	A	A	A	A	2	A	A	A	A	A	A	3	4	5	6	7	8	9	10	11	12	13	14	A							26	13	28	28	10	34
47	4BD18CV093	Vachan. H.M		.	.	.	.	.	1	2	3	4	A	5	6	A	7	8	9	10	A	A	11	12	13	14	15	16	A	A	17							27	29	27	28	10	37
48	4BD18CV095	Vanitha. B.I		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	28							29	29	28	28	10	39
49	4BD18CV097	Vijay. Kumar. H		1	2	3	4	5	6	7	8	A	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27							28	27	26	27	10	37
50	4BD18CV103	Yashaswini. B.S																			1	2	3	4	5	6	7	8	9	A	10							24	28	28	28	10	37
51	4BD18CV105	Yogana. Gowda. B.P		1	2	3	4	5	6	7	A	A	8	9	10	11	12	13	14	15	16	17	18	19	20	21	A	22	23	24	25							27	28	25	A	10	37
52	4BD18CV106	Abhishek. K			1	2	3	4	5	6	7	A	A	A	A	A	A	A	8	9	10	A	A	11	12	13	14	15	16	17	18							28	28	27	28	10	38
53	4BD18CV107	Anusha. N		1	2	3	4	5	6	7	8	9	10	11	12	13	A	A	14	15	16	17	18	19	20	21	22	23	24	25	26							Change of College Left the College.					
54	4BD18CV108	Nuthan. Kumar. L.B		Left College																																						
55	4BD19CV400	Akash. B.H							1	2	3	4	5	6	A	7	8	9	10	11	12	A	A	13	14	A	15	16	17	18	19							28	28	28	28	10	38
56	4BD19CV402	Anusha. B.K		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28							28	28	30	28	10	30
57	4BD19CV403	Ashalatha. H.T																													1	2					28	28	28	28	10	38
58	4BD19CV405	Girish. N. Kabbur			1	A	A	2	3	4	5	6	7	A	A	8	9	10	11	12	13	14	A	A	15	16	17	15	M	20	21							22	20	20	21	10	31
59	4BD19CV407	Harsat. Raj. H.K			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27							28	28	28	28	10	38
60	4BD19CV410	Kiran. Kumar C							1										1	2	3	4	5	6	3	8	9	10	11	12							28	28	28	28	10	38
61	4BD19CV411	Mamatha. B					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25							18	26	27	22	10	32
62	4BD19CV412	Megharaj. M.M.							1	2	3																											27	26	27	26	10	37
		Initials of Teacher		ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ	ADJ												
		Initials of H.O.D.																																									
		Initial of Principal																																									

Class : V 'A' Subject Code : 18CV51 Subject : Construction Management & Entrepreneurship Total No. of Classes :

Sl No.	USN	NAME	DATE	9/9/2020	12/9/2020	14/9/2020	15/9/2020	16/9/2020	19/9/2020	21/9/2020	22/9/2020	23/9/2020	26/9/2020	28/9/2020	29/9/2020	30/9/2020	3/10/2020	5/10/2020	6/10/2020	7/10/2020	10/10/2020	12/10/2020	13/10/2020	14/10/2020	17/10/2020	19/10/2020	20/10/2020	21/10/2020	24/10/2020	26/10/2020	27/10/2020	28/10/2020	31/10/2020	2/11/2020	3/11/2020	4/11/2020	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
63	4BD19CV413	Md. Faran khan		A	A	A	A	A	A	1	A	A	A	A	A	A	A	A	A	A	A	A	2	3	4	5	6	7	8	9	A	A				24	28	28	27	10	37
64	4BD19CV416	Nagaraj. G.M		A	1	2	3	4	5	6	A	8	A	A	9	10	11	12	13	A	14	A	15	16	17	A	18	19	20	21	22					28	24	26	26	10	36
65	4BD19CV417	Nandicha. H.A		A	A	A	A	1	2	3	4	5	6	A	A	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23					28	28	30	29	10	39
66	4BD19CV420	Prasanna. B. Raikar		A	A	A	A	A	A	1	2	3	4	5	6	7	A	8	9	10	11	12	A	13	14	15	16	A	17	18	19					26	28	28	27	10	37
67	4BD19CV421	Rabbani. A.B		1	2	3	4	5	6	A	8	9	10	11	12	A	A	A	12	13	14	15	A	17	18	19	A	20	21	22	23					28	28	28	28	10	38
68	4BD19CV422	Rajath. C		1	A	A	A	2	3	4	5	6	A	8	9	10	11	12	A	A	13	14	15	16	17	18	19	20	21	22	23					23	29	29	27	10	37
69	4BD19CV427	Sharath. E.S		A	A	A	A	A	1	2	3	A	4	5	6	A	8	9	10	A	11	12	13	14	15	16	17	18	19	20	21					28	28	29	29	10	39
70	4BD19CV430	Shubha. M		A	A	1	2	3	4	5	6	7	8	A	9	10	A	11	12	13	14	15	16	17	A	18	19	20	21	22	23	24				28	29	27	28	10	38
71	4BD19CV431	Vani P		A	A	A	A	A	A	A	A	A	A	A	A	A	1	A	A	A	2	A	A	3	4	5	6	7	8	9	A					28	24	28	27	10	37
72	4BD19CV435	Ziyaulla. shareef.s		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	A	A	A	A	16	17	18	19	A	20	21	A					28	28	28	28	10	38

Initials of Teacher

Initials of H.O.D.

Initial of Principal

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - V

CONSTRUCTION MANAGEMENT AND ENTREPRENEURSHIP

Course Code	**18CV51**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction project.
2. Inculcate Human values to grow as responsible human beings with proper personality.
3. Keep up ethical conduct and discharge professional duties.

Module -1

Management: Characteristics of management, functions of management, importance and purpose of planning process, types of plans.

Construction Project Formulation: Introduction to construction management, project organization, management functions, management styles.

Construction Planning and Scheduling: Introduction, types of project plans, work breakdown structure, Grant Chart, preparation of network diagram- event and activity based and its critical path-critical path method, PERT method, concept of activity on arrow and activity on node.

Module -2

Resource Management: Basic concepts of resource management, class of lab our, Wages & statutory requirement, Labour Production rate or Productivity, Factors affecting labour output or productivity.

Construction Equipments: classification of construction equipment, estimation of productivity for: excavator, dozer, compactors, graders and dumpers. Estimation of ownership cost, operational and maintenance cost of construction equipments. Selection of construction equipment and basic concept on equipment maintenance

Materials: material management functions, inventory management.

Module -3

Construction Quality , safety and Human Values:

Construction quality process, inspection, quality control and quality assurance, cost of quality, ISO standards. Introduction to concept of Total Quality Management

HSE: Introduction to concepts of HSE as applicable to Construction. Importance of safety in construction , Safety measures to be taken during Excavation , Explosives , drilling and blasting , hot bituminous works , scaffolds / platforms / ladder , form work and equipment operation. Storage of materials. Safety through legislation, safety campaign. Insurances.

Ethics : Morals, values and ethics, integrity, trustworthiness , work ethics, need of engineering ethics, Professional Duties, Professional and Individual Rights, Confidential and Proprietary Information, Conflict of Interest Confidentiality, Gifts and Bribes, Price Fixing, Whistle Blowing.

Module -4

Introduction to engineering economy: Principles of engineering economics, concept on Micro and macro analysis, problem solving and decision making.

Interest and time value of money: concept of simple and compound interest, interest formula for: single payment, equal payment and uniform gradient series. Nominal and effective interest rates, deferred annuities, capitalized cost.

Comparison of alternatives: Present worth, annual equivalent, capitalized and rate of return methods, Minimum Cost analysis and break even analysis.

Module -5

Arpitha. D.J
Dept. of civil Engg.

Module-1

Management : Characteristics of management, functions of Management, Importance and purpose of planning process. Types of plans.

Construction project Formulation : Introduction to Construction management, project Organisation, management functions, Management Styles.

Construction planning and Scheduling : Introdution types of project plans, Work breakdown structure, Grant chart. Preparation of network diagram - event and activity based and its Critical path method, Concept of activity on arrow and activity on node. Introduction to software, project scheduling tools.

Introduction to project Management

Construction project management has two philosophies

a) Time-driven
b) Cost-driven

Managing cost of Construction project with completion in time with high quality and achievement of objectives is called project Management. A project shall have its own characteristics set so that it can be completed within budget and time. As cost and time for Construction project are Interdependent, it shall be carefully planned. An Increase or decrease in Construction project time affects the budget of Construction projects.

Construction project Management is a Professional Service that uses Specialised, project Management Techniques to oversee the planning, design and Construction of a project from its beginning to its End. The purpose of Management is to Control a project's time, cost and Quality.

Characteristics of Construction Management.

Managing a project is bounded by the limitation of a definite scope of work and a time of completion with a benifits to the user on Completion of project. in a optimised utalisation of manpower and other resources.

1) The project Management should have a Specified target
2) It should be unique and Cannot be replicated with the same task & resorces giving the same results.
3) Satisfy the owers requirement & Expectations from the project
4) It shall Consists of a number of associated activities Contributing to the project as a whole.
5) Time limit for Complition of project shall be defined.
6) Right Co-ordination shall be set-up with all the different departments.
7) It must be flexible to accommodate any Change that might occur during the project.

8) Total Cost of Construction project shall be defined and project shall be Completed within the given budget.

9) It should provide unique opportunities to acquire new skills.

10) Every project has many Constraints in terms of availability of resources and Completion of time.

Importance of Construction Management.

1) Construction Management provides necessary leadership, motivates Employes to Complete the difficult tasks well in time and extracts potential talent of its Employees.

2) C.M provides Importance for optimum utilisation of resources.

3) C.M. is necessary to manage time over run, Escalation of Cost, wastage of resource, unlawful Exploitation of labour & pollution of Envt.

4) It Improves Quality and Speed of work by using modern Equipment & Machinery

5) It arranges the Completion of the work in the Minimum possible time.

6) It Affects the Cost of Const^{n} Economy by adopting new techniques of Construction and Supervision etc.

7) It Checks the Wastage of materials & labours.

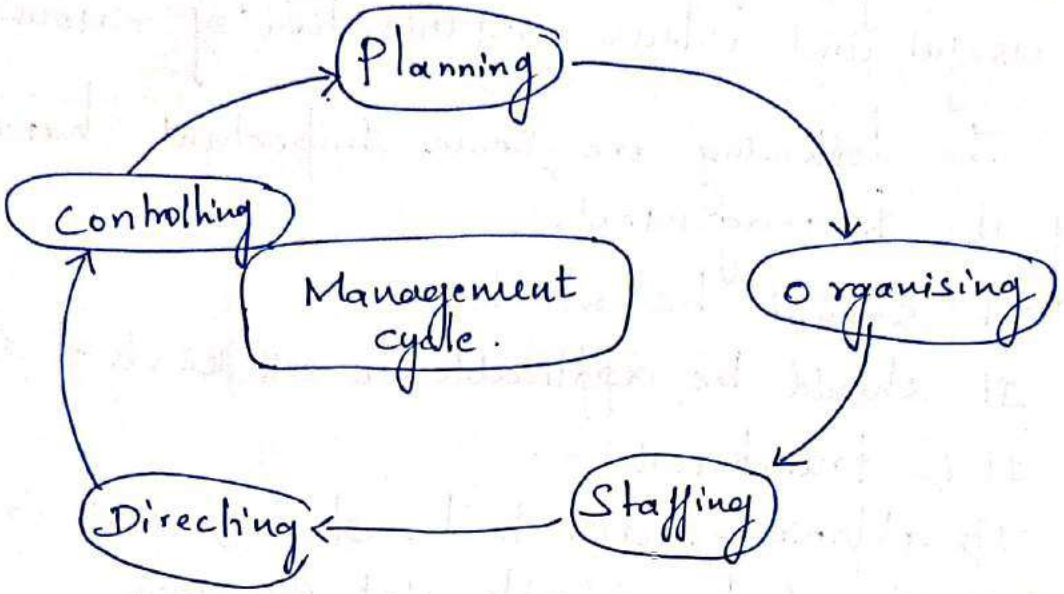
Objectives of Construction Management.

1) The Work should be Executed most Economically
2) The Work should be Executed as per specifications
3) The Quality and Workmanship of the Work should be good.
4) The Work should be planned and organised properly.
5) The Work should be properly Supervised by Qualified and trained staff.
6) The Work should be Completed Within the specified Estimated Cost & time.

Functions of Management (In General)

1) **planning**: Determining in advance What is to be done, Where, When & by Whom.
2) **Organising**: What tasks are to be done
   How the tasks are to be Grouped
   Who report to whom
   Where the decision are to be done.
3) **Staffing**: Filling the staff positions in Orgn
4) **Directing**: Motivating, guidance, supervision.
5) **Controlling**: Measuring & Correcting Individual and organisational performance
6) **Co-ordinating**: Bringing different works of various departments and sections so as to have a good Communication.
7) **Scheduling**: Fixing starting and finishing dates for each activities of the work to execute the Whole work in Syetematic manner.

Management Cycle.



Definition of Management By Management Experts

1) Henri Fayol : "Management is Conduct of affairs of business, moving towards its objective through a continuous process of Improvement & optimization of resources."

2) Mary Parker Follett : "Management is the art of getting things done through people"

3) George. R. Terry : "Management is a process Consisting of planning, organising, actuating & Controlling, performed to determine & accomplish the objectives by use of people and resources."

4) Koontz : "Management is the process of designing and Maintaining an environment in which Individuals working together in Groups, efficiently accomplish selected aims.

Based on vast Experience it has been found that the analysis of Management is facilitated by a useful and clear organisation of knowledge.

The following are some Important Characteristics of the Management.

1) It should be stable
2) It should be applicable to all kinds of Orgn
3) It is transparent
4) Its approaches are to be clear & goal oriented.
5) It should be simple yet Effective.
6) It should be responsive to many External Elements like economic, technological, Social, political & ethical factors that affect the areas of operation.
7) It should have well defined goals and Effective means to accomplish the goals.
8) It should have good planning, organising staffing, directing and Controlling functions.
9) It should provide Conductive atmosphere of work.

planning

planning is the most basic function of Management. It is referred to as "deciding in advance" as to what to do, how to do, when to do and who has to do it etc. It is an Intellectual process which requires a manager to think before acting. nothing but thinking in advance.

planning Involves selection of objectives and goals and Determines the ways and means of achiving them. They we can easily says "The planning bridges the gap from where we are to... where we want to be.

Nature of planning Indicates Essential Quality or general characteristics of planning.

1) It Must Contribute to accomplish purpose & objectives
2) It Must be considered as parent Exercise in all processes
3) It Must spread through all Management functions
4) It must be effecient in such a manner so as to achieve the designed goals at the least Cost.

Importance of planning.

planning is the beginning of all other functions of Management. Without planning, business decisions would become difficult.

1) Uncertainity and Minimize Risk.

In Complex situations planning provides logical facts and procedure to Managers for decision making. This logical decision making based on plans to organise and Minimises uncertainty and risk.

2) Effective control : Goals & plans become standards or bench marks against which performence can be measured. Thus good plan facilitates effective control on the activities.

3) Focuses attention and Concentration on objectives of Enterprise : planning Makes the Entire org^{n} to walk towards the goals and Create Co-ordination in accomplishing the goals.

4) Economic operation and leads to Success

If the work is planned in advance, there will be no Confusions arising and things will happen as per plan and achieve goals. This results in economical operation and reduces uncoated expenditure.

5) Bridge b/w present and future : A proper & systematic plan forms the bridge b/n What we are today & what we want to be in future. It is very difficult to accomplish goals. Hence planning is very Important for Success of any org^{n}.

Planning Benefits.

The project plan comprises time plan, resource plan and plan for controlling project. It also includes schedules of design and drawing preparation, work quantities, progress of work planned resources allocated to project, budgeted costs & cash flow Estimates.

1) project plan clearly defines project's scope of work.
2) project plan aids the management in performing its functions efficienty and effectively.
3) phoject plan forms the basis of project operations and directions and shows how the project is to be run.
4) project plan identifies critical activities, thus enabling the managing of project by exceptions.
5) project plan provides yardstick for measuring progress and evaluating resources performence.
6) project plan provide the basis for co-ordinating the efforts of clients, consultants, architects, designers, quantity surveyors, specialists, Contractors and project staff.
7) Project plan Maintains Continuity of work, specially when project organisations is temporary and its staffing is transient in nature.
8) P.P Creates healty Environment.

Well Conceived project plans, developed before the commencement of project execution stage, can go along way to prevent project collapse on account of Mgt failures

Purpose of planning.

1) To direct all other functions of Management.
2) To Select Many available alternatives, so as to achive the objectives of the Enterprise, Ccouomically, Effectively and Efficeutly.
3) To set up the goals of an Enterprise in perspective, within the Environment.
4) To help planned goals of an Enterprise to break-up into more easily handlable additive segmented goals.
5) To form the basis for budget
6) To forecast the future to avoid uncertainty and change.
7) To provide Effective Control
8) To Serch for alternatives & adopt the best weey of accomplishing the work
9) To focus the vision on the objectives & goals.

Req. of objectives

- Objectives must be clear and must be acceptable
- the objectives must support one Grothers
- Objectives must be precise
- Objectives must be Measurable
- objectives must be realistic & valid ones.

Types of plans

Based on the nature of planning, the planning is classified as ① Tactical planning
② strategic planning.
③ operational planning
④ Contingency planning.

① Tactical planning.

→ Tactical plan is Concerned with what the lower level units within each division must do, how they must do it & who is in charge at each level. Tactics needed to activate the work.

→ Tactical plan are Concerned with shorter time frames and narrower scopes than strategic plans.

→ This plan runs one year - or less so that they are Considered as short term/s.hange planning

→ It makes a proper usage of facilities & resource

→ This plan is more detailed since it Caters to day-to-day operations and activities of the organisation.

→ It is based on performance & is less uncertain.

→ This plan is done at lower levels of Management.

② Strategic planning.

↳ A strategic plan is an outline of steps designed with the goals of the Entire organisation as a whole in mind, rather than with the goals of specific devisions or departments. This type of plans are begins as a Organisation's Mission.

↳ Strategic plans look ahead over the next two, three, 5 or even more years to move the organisation from where it Currently to the position Where it wants to be.

↳ This plan requiries Multilevel Involvement & demand all levels of management within the organisation.

↳ This plan is done at top level management and Consists of major goals & policies of an organisation & resources & facilites to accomplish the goals.

↳ It is Completely based on long term goal and it is more uncertain.

③ Operational planning.

↳ Operational plan is to accomplish his or her Job responsibilities. Supervisors, team leaders & facilitators develop operational plans

↳ Based on the usage of developed plans it can be further stated as
- single use plan
- standing plan
- or ongoing plan

↳ In single use plan, plans are developed to achieve a specific End. After reching that target the plans becomes useless.

↳ Single use plans are apply to the activities that do not recur or repeat.

↳ standing plans / ongoing plans are usually made once and retain their value over a period of years and used again and again

Examples for standing plans or ongoing plans

① Policy : policy is a verbal, written or Implied overall guide, setting up boundries that supply the General limits & direction in which managerial action will takes place. Thus policy is a General guidline for the decision making.

policies are general statements that Explain how a manager should attempt to handle routine management responsibilities. Different policies of organisation like personal policy, promotion policies, marketing policy, purchase policy, pricing policy, recruitment policy, distribution policy, payment policy, wages & Incentives policy etc.

② Procedures

procedures are the detailed guidelines that are used to carry out the policies. A procedure provides a detailed set of Instructions for performing a sequence of actions. procedures are followed every time when that activity is perforced. It may also Exist for Conducting meetings of board of directors, Shareholders, Issuing raw materials from stores, packaging of finished goods, Inspection etc

③ Rules : A rule is an explicit statement that tells an Employee what he or she Can & Cannot do. Rules are do and don't statements put into place to provide Equality among all. Rules are detailed and recorded Instructions that a Spetific action must or must not be done under the given Instructions. Eg: Reporting time, lunch time, availing of leaves, use of LTC facility etc.

④ Methods : A Method is a prescribed way in which one step of a procedure is to be carried out. Thus we can say Method is a part of procedure. A procedure has a number of steps, each step may have number of Methods to do it. Methods helps in increasing the Effectiveness of a procedure.

④ Contingency plan

↳ Intelligent and Successful Management depends upon a Constant pursuit of adaptation, flexibility and Mastery of Changing Conditions.

↳ Strong Management requires a "Keeping all options open" approch at all times - that's where Contingency planning comes in.

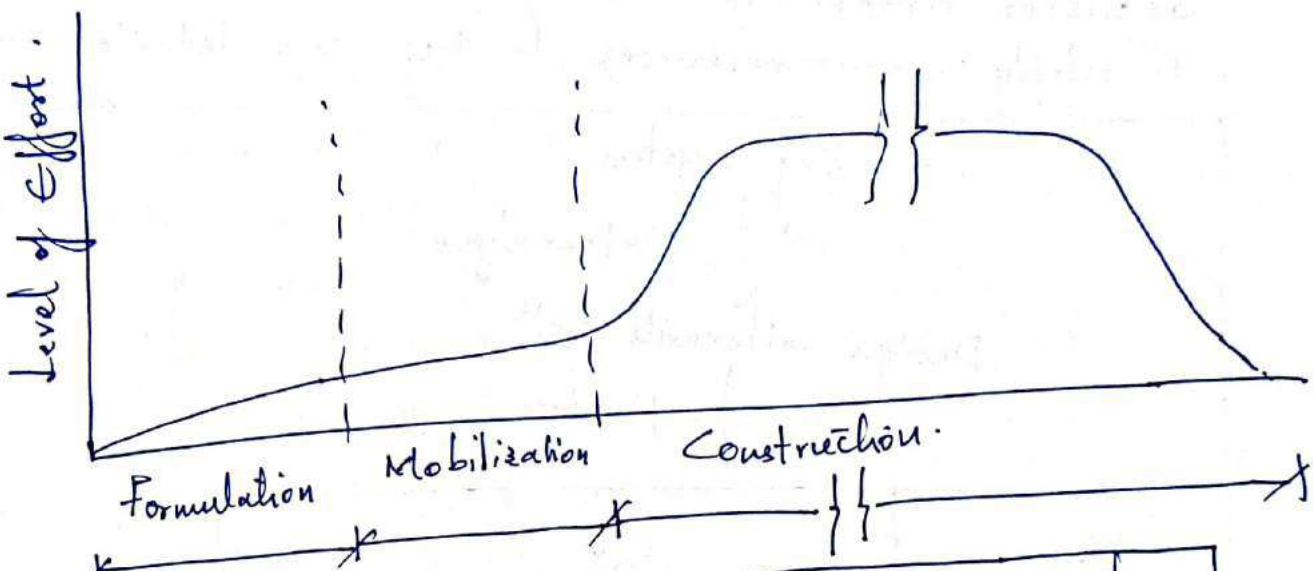
↳ Contingency planning Involves Identifying alternative Course of action that can be Implemented if and when the original plan proves Inadequate because of Changing Circumstances.

Note: Operational plans lead to the achievement of tactical plans, which in turn lead to the attainment of Strategic plans. In addition to ③ plans Manager should also develop Contingency plan in case their original plan fails.

Construction project formulation.

Project are has a predetermined duration with a definite beginning and an Identifiable End. Its starting point is the time when the idea is Conceived by the client and its End marks the time when the mission is accomplished. The time span b/n the start and Completion of a project represents the project life cycle.

Life cycle of a typical Construction project



Formulation stage

a) Project idea Conception
b) Feasibility studies
c) Investment appraisal
d) project Definition.

Mobilisation stage

a) project praliminary plan
b) Designs & drawings
c) Specifications & Contract finalisation
d) Resources Mobilization & Carmarking funds

Construction stage

a) planning & Controlling Execution
b) Inducting resources.
c) Construction & Commissioning
d) final handling over to client.

Project Preparation / Project formulation

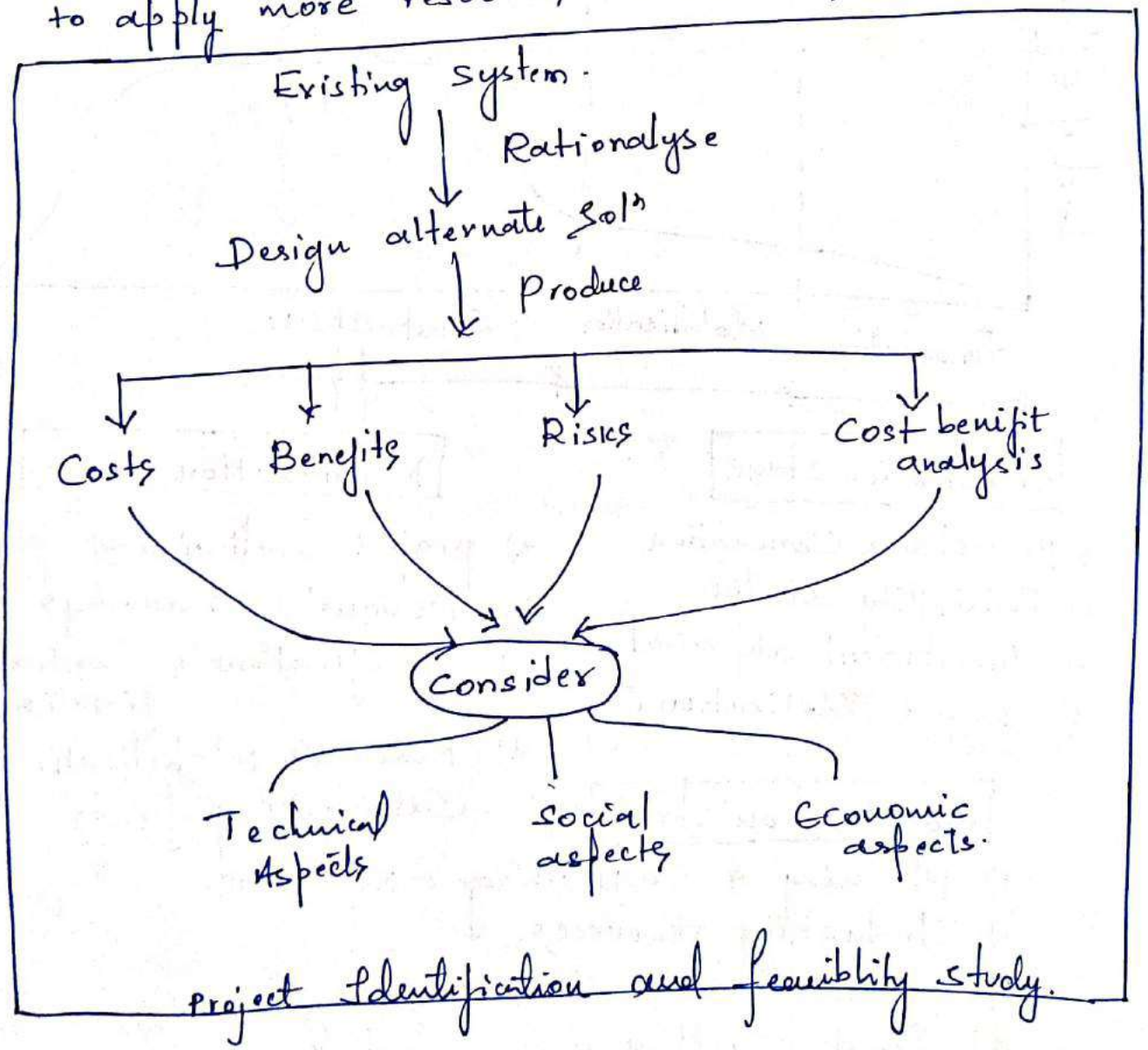
Project preparation / formulation phase decides whether the project should be Executed or not.

Project formulation is done in 2 ways.

a) Preliminary project study or project idea Conception

b) Feasibility studies.

@ In preliminary phase, Informations related to Project are Collected and analysed to help the decision maker to decide whether it is desirable to apply more resources to take up detailed study.



(b) The Feasibility study Evaluates project potential by examining technical feasibility, Economic Viability and financial Implications. The subject to be Covered in the feasibility report of a Construction projection will depend upon the purpose of the report & the nature of project.

Typical Feasibility report of an Industrial project

↳ proposed project reports with product features.
↳ Demand Survey – costomers demand & sale potiential
↳ Tecnical studies – Totally from Construction Methodology to the statement of project time & cost objechives.
↳ Financial Implications – Project budjet, profitability trend, payback period, Sources of financing.
↳ Economic Viability – Cost-benifit Analysis.
↳ Summary of Recommendations.

For the formulation of a project the above mentioned points are taken in to Considerations.

Finally, the process of formulation of project needs

a) Collection of Information
b) Critical Examination of Concepts and Re-examination of needs – till project finally takes shape.
c) Implementation details.

For Complete Details.
Refer: Construction project Management. by K.K. Chitkara
Page: (14) to (20)

Points to be Included in Feasibility study.

Complete Report of for the project formulation.

1) Goveronament policy in with respect of Industry in which project is Under Considerations.
2) Specifications of the output & technique of production.
3) Capacity (production)
4) Alternative locations.
5) Preliminary Estimates of revenue, Costs and Capital Investment and operations.
6) Marketing analysis / demand Analysis
7) Objectives of the proposal
8) Raw Material Investigation
9) Estimation of Material, Energy & other Input cost
10) Requirement of Equipment with their type, capacity cost and Sources of supply.
11) Site Investigation
12) Details of Building structures with their type, size & cost.
13) Details of Layout.
14) Category wise labour Requirements & labour Costs.
15) operating costs & norms.
16) Estimation of Working Capital, Phased Expenditure and Cash flow requirements.
17) profitability (revenue & benefits Estimation)
18) How to Sort out Environmental problems
19) Resources available to Complete the project.

for more.. study. S.C. Sharma.
Const^n Equipment & its Management.
unit: project planning Projectology Pg: 698 to 723.

Project Organisation.

A project organisation is a structure that facilitates the co-ordination and implementation of project activities. Its main reason is to create an environment that fosters Intractions among the team members with a minimum amount of disruptions, overlaps and conflict. One of the important decisions of the project management is the form of organisational structure that will be used for the project.

Each project has its unique characteristics & the design of an organisational structure chart. The structure defines the authority by means of Graphical illustration called an Organisation Chart. A properly designed project organisation chart is essential to project success.

project organisation is temporary, it creases after completion of project. It is conceived during the project Conception stage and it comes into Existence at the start of planning stage. It grows gradually. It undergoes changes in various stages of the project life cycle to meet project needs. Towards the End, it runs down and ceases after completion of the project. Its special attributes Include its Innovation Capacity to overcome problems as they arise. It is staffed with Experienced person to respond speedly with changing situations & to speed up decision making.

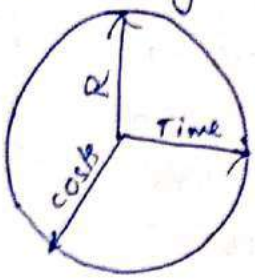
Guidelines for designing project Organisation.

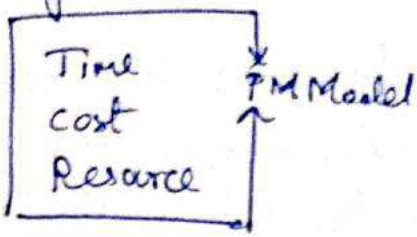
1) Organisational groups are designed to generally conform with the project Work breakdown.
2) Each group is assigned responsibilities and allocated resources to meet the assigned tasks.
3) The size and structure of the organisⁿ is changed due to alteration in requirements, however the core project team continues till the End.
4) project groups are suitably structured with Emphasis on team work & Informal relationship
5) Orgⁿ structure is kept flat to avoid bureaucratic tendencies & Reduce Channels of Communication with the project manager.
6) Key staff is derived from their respective parent departments in Corporate office and their Interfaces and Communication links
7) The heads of line & staff departments are Generally grouped in to project management team and planning chief is assigned to the Resposiblity of Co-ordination function.

Management of a Construction project mission entails multidirectional Interaction of dynamic forces represented by its
- time
- Resource Constraints
- carrying costs.

Line b/n
- How to manage time
- How to manage Resource
- How to stay within budject.

Management of Const^{n} by project Management Model.





P M. Model leads to achive the project mission
↳ Within the project time, cost and Quality
↳ By planning, Organising, co-ordinating, monitoring and Controlling the available Resources
↳ Managing the organizational behaviour with the assistance of the project team & the Spacialists.

1. Purpose of An Organisation.
2. Principles of Organisation
3. Types of Organisation

Refer: Management & Entreprenership
by: N.V.R. Naidu
T. Krishna Rao.

Page No. (33) to. (45).

Project Management Functions

① Planning : planning involves deciding in advance what is to be done, how & in what order it is to be done to achive the objectives.

planning and Scheduling involves

- → Crystallising objectives
- → Collecting & Synthesising Information
- → Developing alternative Course of action within specified Constraints
- → Comparing alternatives
- → Selecting and Scheduling the optimum Course of action.
- → Establishing policies, procedures, methods, schedules, programmes, Systems, Standards and budjects for accomplishing project objectives.

② Organising : Organising is the process of establishing a Structural relationship among functions of people, so as to formulate an effective machinery for streamlining the achievement of assigned objectives.

Organizing Involves

- → Dividing the Work in to Component activities
- → Designing Job Structures
- → Defining performance targets & Responsibilities
- → Allocating resources
- → Delegating authority with responsibility.
- → Establishing Structural relationship to ~~reduce~~ Co Secure Co-ordination.

(3) Procuring. : It Implies manning and keeping manned the positions created by organization structure and providing them the right quality resources at the right time. The resource include people, Materials, Machinery & Money.

→ preparing resource procurement schedules
→ Developing specifications for required resources
→ Deciding appropriate sources of procurement.
→ Budgeting resources & arranging approvals and purchase.
→ Preventing wastage during resource holding at site.
→ supplying on time required quality and quantity of resources to project construction.

(4) Directing or Leading : It Involves influencing people so as to enable them to contribute to organisational goals efficiently & effectively. Direction implies the following tasks.

→ providing effective leadership.
→ Motivating participants behaviour.
→ Communicating Instructions & orders.
→ providing suitable climate for subordinates development.

(5) Controlling. Controlling Involves monitoring of the performance and applying Corrective measures in case of deviations from the plan.

→ specifying the factors to be Controlled
→ Stating the methods of Measuring Control factors.

↳ Evolving systems for generating performance data.

↳ Monitoring data received and formulating corrective options.

↳ Applying Corrective measures to put a plan on the scheduled path.

↳ Replanning when necessary.

Management Styles

Local Culture, Customs and nature of the project, nature of the team, personality and skills of the project managers defines the Project Management styles.

The following are the four distinct Organisation management styles that have strong influence on how project are managed.

1) Autocratic
2) Paternalistic
3) Democratic
4) Laissez-faire

① Autocratic / Authoritarian

↳ Manager keeps the higher position and makes all the decisions, keeping the information and decision making among the senior management.

↳ Objectives, tasks are set and the workforce is Expected to do exactly as required.

↳ The Communication Involved with this method is mainly downword from leader to the subordinate

→ This Method can lead to decreare in Motivation from the Employee's point of view.

→ Advantage of this style is .. the dirn of the Organisation will remain Constant and the decisions will be similar, this in turn can Project is an Image of a Confident, well managed orgn.

↳ In this style team members dependend on the project Manager's decision and supervision may be needed.

② paternalistic :

→ In this styles the manager makes decisions in the best Interests of the Employees rather than the Organisation.

→ The Manager Explains most decisions to the team members and ensures that their Social and leisure needs are always met.

↳ This can help balance out the lack of staff motivation Caused by an autocratic management style.

→ Feedback to the Management will occur in order for the Employees to ~~be~~ keep them happy.

→ This style makes loyalty & leading to a lower staff turnover and meet Social needs.

→ Disadvantage of Paternalistic style is ---
Employees become highly dependent on leaders.. If their leader takes wrong decisions ~~are made~~ employees may become dissatisfied with the leader.

③ Democratic

→ Manager allows the Employees to take part in the decision-making where everything is agreed by the majority.
→ This style can be particularly useful when complex decisions need to be made that require a range of specialist skills.
→ Job satisfaction and quality of work will improve.
→ Decision making process is severely slowed down and conflict around the employees create the problems in taking best decision for the project.

④ Laissez-faire

→ The Manager's role is marginal and the Employees manage their own ~~style~~ areas with in the project.
→ Hear Manager evades the duties of Managment and uncoordinated delegation occurs.
→ Communication in this style is Horizontal, it means Equal in both directions, however little Communication occurs in Comparison with other styles.
→ Adv: Best in bringing highly professional and Creative groups of Employees.
→ Dis: poor Management, lack of staff focus which in turn leads to much dissatisfaction and create poor organization Image.

Construction planning and Scheduling.

Construction planning / project planning is the starting point of all management functions. planning leads to organising and staffing followed by directing, controlling and co-ordinating.

For Any project, planning is neccessary. There are two Important tools known as Critical path Method 'CPM' and program Evaluation and Review techique 'PERT'. These two Can help us for smooth running and reviewing the work Carried out to a Certain period Such as planning is neccesary in order to Construct the project within the Cost and on time.

For proper planning we need.

1) The Identification of specific activites or works required and the Interrelationships b/n those items
2) proper Sequencing the specific activities of work so as to Complete the project with the optimum amount of time.
3) Time for delivery of Material & Installed Equipment
4) Types, Quantities & duration of Const^{n} plants & Equipment
5) Classification and numbers of workers needed at the period of time they may be needed
6) Financial Assistance for the respective timing.

Scheduling

Scheduling is the process of fitting the work plan to a time frame indicating the start & completion of each activity. It also shows sequential relationships among various activities. Schedules are prepared for Construction resources such as labour, material, Machinery and money required at various stages of work. The actual progress of each activity can be monitored with reference to the planned programme. If there are any delays, suitable corrective action plan can be taken to speed up the work.

A Construction schedule is a tool that a Contractor uses to manage time and execute activities in a proper sequence. To prepare a Construction schedule, the project is divided into different activities or operations. The sequence of operations can be divided into ~~different~~ activities or operations decided after knowing their inter-relationship as per the Construction method adopted.

The Construction scheduling serves the following purposes i) Making availability of time table showing the schedule & sequence of activities

ii) Providing a schedule for Monitoring the progress of work and taking corrective measures if required.

iii) Providing a means of establishing and maintaining time goals & prioritising activities.

Types of project plan.

planning the Entire project from its Inception to Completion requires a vast Coverage, varied skills and different types of plans.

1) Project feasibility plan. or/ Inception stage

planning by the client begins as soon as he gets the idea about developing a facility to fulfil certain motives. The Feasibility study Examines the needs of client and ways to fulfil those ideas. It defines the overall scope of work and breaks it down into various task groups. It develops an outline plan of work, and assesses the time and costs of Accomplishing the project. Thus by outlining the details of plan by feasibility teham during the inception stage, ~~forms~~ ~~the~~ objectives of the project are achived.

2) project preliminary plan. / Engineering stage

Acceptance of feasibility studies marks the Commencement of the preliminary plan-making process. Its main aim is to provide direction to the client managers & staff Employed during the development phase of the project. The project preliminary plan forms the basis for developing the project Construction plan.

preliminary plan Includes.

1) A project time schedule and the skeleton network to highlight the work dependencies, project milestones and the Expected project Completion time.

2) Project designs and drawing preparation Schedule.

3) A breakdown of project work into Contracts, along with a schedule of Contracting activities, Including the tender preparation period, tender finalisation period and Contracted works commencement and completion dates.

4) Requirement of men, Important materials, plant and Machinery.

5) Resources procurement System.

6) project organisation & staffing pattern.

7) preliminary forcast of funds requirement.

3) Project Construction plan / Implementation stage

Construction of project facilitates to the Project Management team headed by the project manager or the resident Engineer. This team may be Clients own Construction agency or from a Client-appointed Construction Consultant or from the Suitabl organised Combination from there. The planning Chief develops the project Construction plan Includes the Contracted works and Commissioning plan as applicable.

The project Construction plan Include the following

1) Time plan: It depicts the schedule of project activities for completion of the project within the specified time

2) Resource plan: It forecasts the required Input resources of men, materials, machinery and money for achieving the project Completion time target and cost objectives.

3) plan for Controlling project: It Encompasses the design of Control system, monitoring system, Codification system and the Computerised Information System.

Project planning Techniques

Stages	Planning Process	Techniques/ Methods
Planning Time	Breaking down project work Developing time network plans Scheduling work	Work breakdown Network analysis (Gantt chart) Line of Balance technique. Time & Resource limited Scheduling.
Planning Resources	Forecasting resource requirements Planning manpower requirements planning materials requirements planning Equipment procurement Budgeting costs Designing Organisational structure. Allocating tasks & resources	Forecasting Manpower Scheduling. Materials Scheduling Equipment Selⁿ & Scheduling. cost planning and budgeting. Organisation design. Resource allocation.
Planning Implementation	Formulating Monitoring methodology.	Resource productivity Control Time Control Contribution Control Budgetary Control.

v) To avoid the unnecessary delays or stoppage of work due to lack of materials, machines, etc.

vi) To control the overall progress of work.

WORK STUDY

It is the collective term used to indicate twin techniques of time study and motion study. The aim of work study is to provide the actual data to assist the management to obtain the possible use of material and human resources in carrying a specified activity.

i) **Time study:** - It is the analysis and determination of least time required to perform a given task.

ii) **Motion study:** - It determines the movement of men, materials and machines to complete a task with the object of increase in the production by improving the sequence of operation.

Time and motion studies can be used for the following purposes:

a) To select most economical methods and sequence of operations for the construction work of frequently occurring nature.

b) To determine the most effective size of crew to execute a particular operation.

c) To compare the equipment performance on a unit cost of production basis.

d) To select the equipment for use on a specific job.

CONSTRUCTION PLANNING

Planning is 'deciding in advance what is to be done'. Planning is the most important technique of management. Planning is necessary to ensure proper utilisation of human and material resources to achieve the objectives of the project. In any project, the plan includes the estimates; the budget and time schedule and sequence of completion of each part of the project, manpower planning and the plant and equipment.

Object Of Planning

The main objective of planning is to execute the project most economically both in terms of money and time. Effective planning includes the following factors.

1. Proper design of each element of the project.
2. Proper selection of equipment and machinery. In big projects, the use of large capacity plants are found economical.
3. Proper arrangement of repair of equipment and machinery near the site of work to keep them ready to work.
4. Procurement of material well in advance.
5. Employment of trained and experienced staff on the project.
6. To provide welfare schemes for the staff and workers such as medical and recreational facilities.
7. To arrange proper safety measures such as proper ventilation, proper arrangement of light and water.

Principles of Planning

1. The plan should provide information in a readily understandable form.
2. The plan should be realistic.
3. The plan should be flexible.
4. The plan should serve as a basis for project monitoring and control.
5. The plan should be comprehensive.

Types of Project Plans

CONSTRUCTION PLANNING

The construction planning is an administrative process which translate the policy into the method of achieving the desired goal.

This involves

1. Job planning
2. Technical planning
3. Pre-tender planning and Post-tender planning

1. Job planning

Job planning of construction work involves the division of the work into different stages in sequence and each stage of work being properly specified. It is carried out as follows: -

i) **Manner of execution of job:** It is to be done to decide that the job has to be done departmentally or through the contractor.

ii) **Duration of job:** A time limit has to be specified for the completion of the work, which depends on urgency of the work and availability of fund.

iii) **Planning resources:** Resources like plants, machinery, equipment, labours, technical and non-technical supervisors, staffs, skilled and unskilled labours has to be arranged.

2. Technical planning

The technical planning is done by an engineer for economical and safe execution of the work. It is carried out as follows:

i. **Preparation detailed drawing and specifications:** An estimate of the project is prepared only when there are related drawings and specifications are first prepared.

ii. **Preparation of detailed estimate:** The detailed estimate is prepared to arrive the exact cost of the project.

iii. **Finalising method of execution of work:** It has to be decided whether the execution of work should be carried out departmentally or through contractor or by any other system. If it is by contractor then the type of the contractor and contract agreement are determined.

iv. **Planning resources:** Proper planning is made to arrive the necessary resources like machinery, labours, etc., in advance to avoid the delay and discontinuity of the work.

v. **Checking of stages of procuring resources:** This is very essential to know whether the required resources are available for the construction work or not.

vi. **Visualisation and remedies of obstacles:** The engineer has to be visualised before handling the construction whether there is an obstruction which may obstruct the construction and for that remedial measure are taken to prevent the obstacles in construction work.

The following are some of the important points which have to be considered at the stages of technical planning:

Resources: The following points have to be considered:

(a) Availability of site.

(b) Availability of stores.

(c) Availability of labour.

(d) Availability of equipment and plants.

Works plan: A comprehensive plan showing the following particulars should be prepared:

(a) Various stages in planning.

(b) Fixing responsibilities for each stage and timing of these stages.

The work plan thus prepared should show logical development of the various stages.

3. Pre-tender and Post-tender planning

Contract planning is divided into the following two categories:

i) Pre-tender planning.

ii) Post-tender planning.

The above two categories are explained below:

i) Pre-tender planning

The planning required for the time of inviting of tender's up to the receipt of the same is termed as per-tender planning.

It includes the following:

(a) **Finalisation and acquisition of site:** Before placing an order on the contractor for starting the same, it is necessary that not only the selection of site should be finalized but the same should be acquired as well.

(b) **Planning of resources:** It is necessary to know the availability of materials, machinery, equipments, skilled and unskilled labour, etc.

(c) **Time limit for each work:** Time limit and resources are inter-related. If the resources are available, the time limit for a job can be determined but in case of urgent works if the time period for the completion of the work is already specified then it is necessary to plan and arrange the required resources.

ii) Post-tender planning

After the acceptance of tender, the contractor prepares further detailed planning.

Post tender planning for proper execution of work includes the following:

1. The work is divided into different units and a responsibility for each work is fixed.
2. A work diary is maintained to record every days work done.
3. The quantities of materials required at each stage of work is estimated.
3. Bar chart or program progress chart are prepared to indicate the planned progress.
4. Availability of labour and materials checked in advance for every stages of work.
5. Planning for the location and other details of camp offices, layout of site, temporary accommodation for labour and staff, drinking water facility, etc.
6. Planning and arranging for transport of labour to the site and back.
7. Arranging repairs and maintenance of machinery and equipments.

JOB LAYOUT

The job layout is the plan draw to a scale before starting project showing area available for offices, warehouse, storage of materials, equipments, workshop, fabrication yard. The areas allotted for each item should be such that the time consumed in carrying materials to project site is minimum.

Factors affecting the job layout

1) Nature and type of work

The nature and type of work determines the size of the project camp can be located at the site. Example: If the construction is of highway a number of small camps will have to be established, if the project is the construction of dam or residential building then the entire project construction unit can be established at one place.

The job layout for a Earthen dam or canal lining will be quite different from that of a multistoreyed building as the nature and extent of requirements of supporting facilities are quite different in each case.

2) Location of the projects

The job layout is determined by location such as the distance of the project from the main highway and railway and topographical features such as rainfall, snowfall,etc.

3) Method of execution of the project

It depends upon whether the project is executed departmentally or through contract agency.

4) Nature of the ground

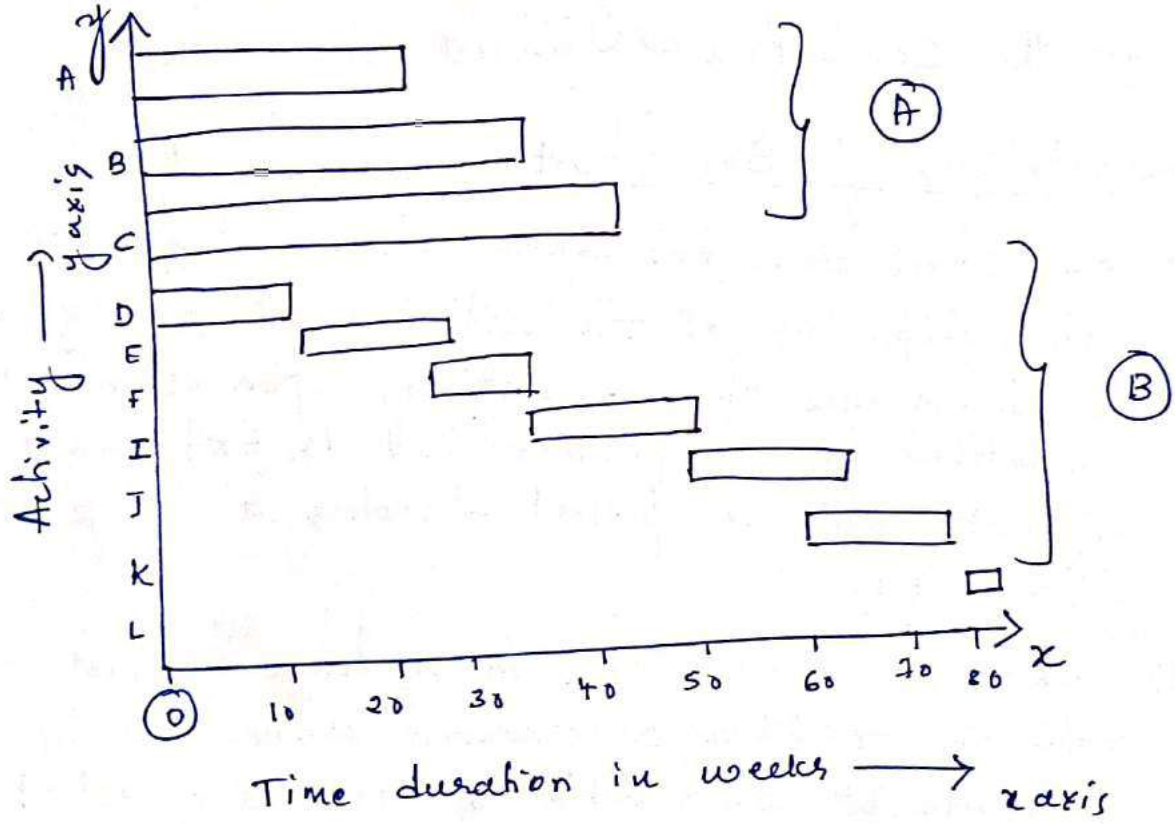
For the movement and erection of equipment and machines strong and solid ground is essential.

Bar Chart / Grantt Chart

1) It is a pictorial representation showing the various jobs to be done with respect to the time and also with money involved.

2) It consists of two co-ordinate axes, one representing the time elapsed and other by jobs or activities performed.

3) The jobs are represented in the form of bars. The length of the bar indicates the duration of the job/ activity takes for completion.



(A) + (B) Makes a Job Complition.

4) By the Gantt / Bar Chart Representation we can Conclude that some of the bars run parallel or overlap each other by time wise & some run serially with the completion of other Bar.

5) A, B, C, D starts / run parallely, E, F, I are overlapping with the activity A, B, C and J starts only after Completion of C activity. K starts in b/n the J activity and L starts after Completion of K activity

6) So By Conclusion we can say that the bar Chart itself Explinatory. by showing various activity along vertical axis & time for the Completion of project alon X-axis.

Limitations of Bar Chart / Gantt chart.

1) Bar Chart does not show clearly the inter-relationships of all the activities. This requires the dependence of one activity upon another to be remembered by the planner. This is Extreamly difficult when a project Involves a large number of activities.

2) When a delay occurs in a large project, many activities tend to be crashed unnecessarily as it is almost Impossible to remember which activities in bas Chart are Interdependent.

3) Barchart doesn't show the project progress.

4) It doesnot reflect the uncertainty or tolerances in the duration time, Estimated for various activites.

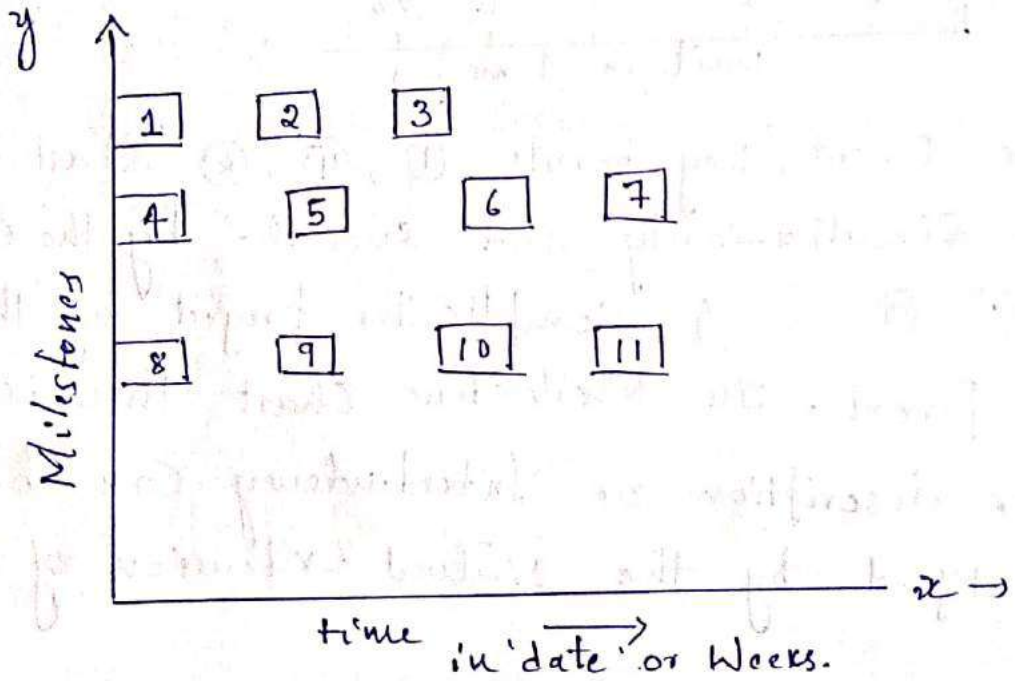
5) It doesnot Indicate critial areas of work.

Milestone charts

1) The Modification of Gantt chart by adding new Elements called PERT or CPM network is termed as Milestone charts / M-system.

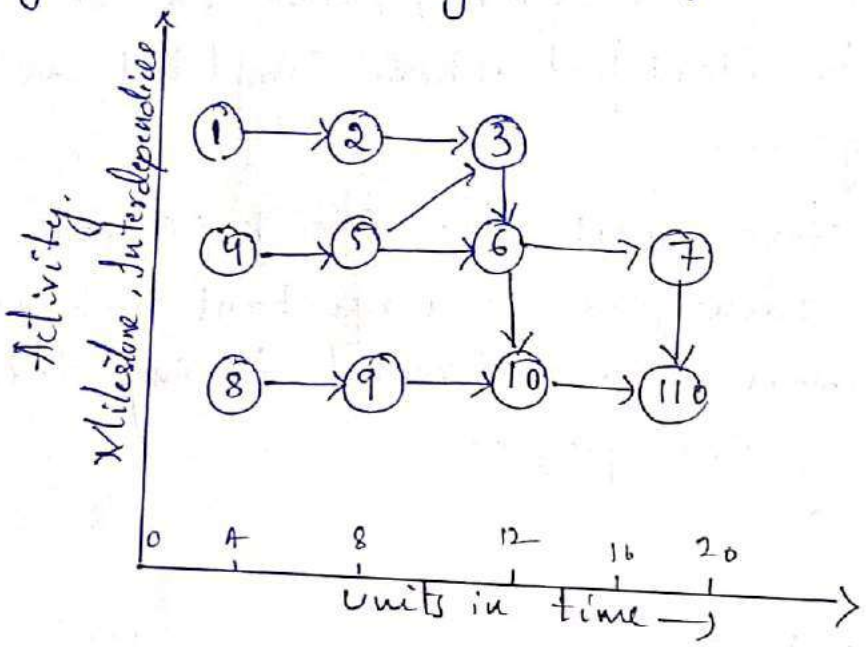
2) Milestones are key events / points in time which can be identified when Completed as the project progresses.

3) In Milestone Chart, the Specific events which has Identified as important reference points [Number with a Event] during the completion of the project



4) Long-time jobs are identified in terms of Specific events or milestones. This Milestones or key events are plotted against the timescale Indicating this achivements by specified dates or weeks

5) Milestone chart, are in chronological, but not in a logical sequence. So a natural extension of milestone chart as a NETwork is Introduced where the events are Connected by arrows in logical Sequence.



Heare Event / key points ①, ④, ⑧ start up with Simultaniously and succeded by the Event ②, ⑤, ⑨ .... & complte the project by the ⑪th Event. In Mileistone chart there is an clear description or Intedendency can be Identified by the Naked Extension of M.S chart.

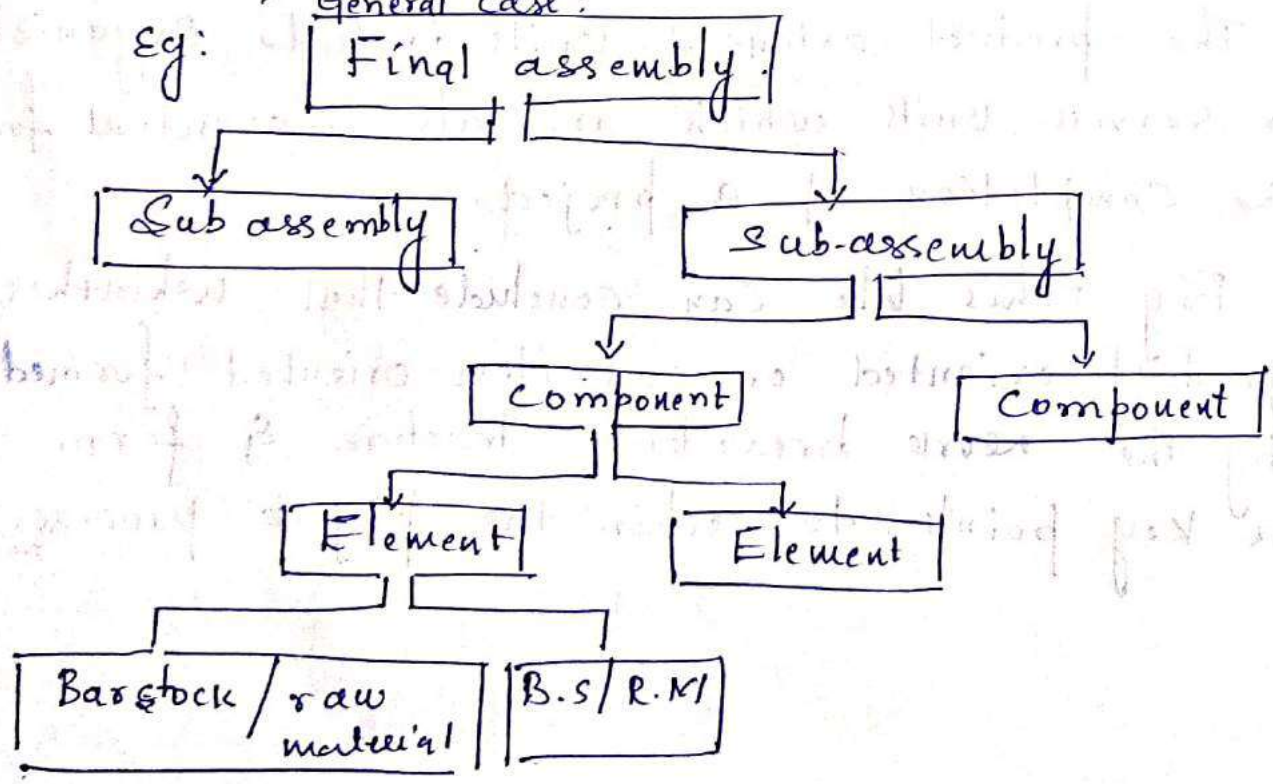
Explain work break down structure of a project with an Example.

1) Bar charts are successfully modified by adding new elements in order to progress a project. This Modification is termed as Milestone.

2) This Milestone chart got definitely an Improvement on the bar chart & brings the functional Elements of programme & their Interrelationship. This is achived through the process known as "Work break down str". also know as Indenture level structure.

3) This structure Establishes the hierarchial order in a system.

General case:



4) In the above fig. broken down systems are Explained. System to Sub-Systems & each Sub-systems to Sub-sub-systems, Every of the Sub-sub-system reduces to Major Component, minor Components & so on... The breakdown is Continued untill the assembly is reduced to elements or Components representing managa -ble units for planning & Control.

5) The Several units in the breakdown Could be either end-item oriented or product oriented.

6) End-item oriented units are the ones which form a necessary part of finial item which acts as a transmitting system or a Control unit in the final deliverable system.

7) The product oriented units include Organizal or service units which are also Essential for the Completion of a project.

8) By this We Can conclude that wheather product oriented or end-item oriented formed by the work breakdown structure & form a key points. to achive the project process.

Explain. a) PERT and CPM b) Critical path.

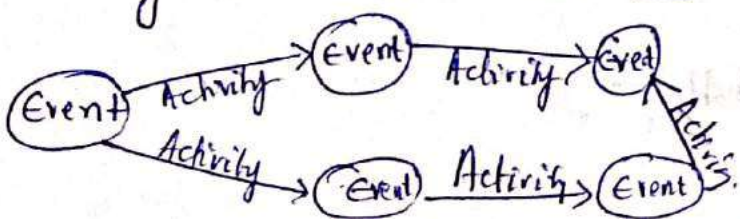
1) Project Management has Evolved as a new field with the development of two 'analytic' techniques for planning, scheduling & Controlling of projects. These are termed as PERT & CPM
PERT: project Evaluation & Review Technique
CPM: Critical path Method.

2) Both this tools define's & Co-ordinate various activities of a project & Successfully accomplish the objectives on time.

3) PERT & CPM helps managment in reducing the project Excecution time.

4) PERT & CPM Tequneses provides additional Information through their network analysis on which the better decisions can be done.

5) There is a Sort of continutity to CPM & PERT networks, it Consists of two basic elements in a Network plan. ACTIVITY & EVENT. The activity Stands for time-Consuming part of project by refrensting Job. The EVENT also knows as NODE Respresent Either begueng or End of the Job. Activities are denoted by arrows ⟶, & the Event by circle ○ or Rec □



6) Pert Network is Event based.

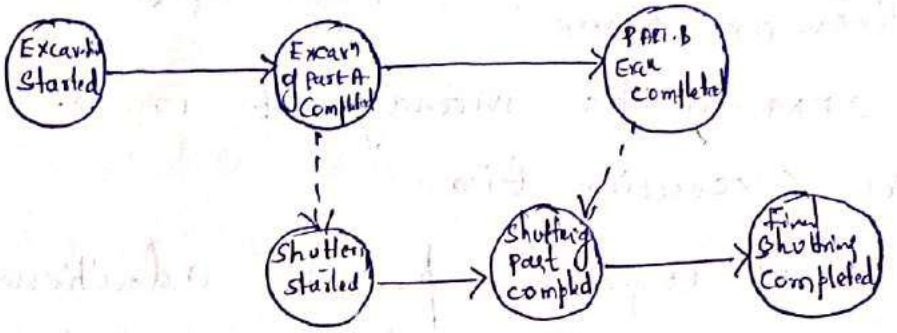
a) It must indicate a note worthy or significant point in the project.

b) It is the start or Completion of the Job.

c) It does not Consume time or resources

d) Activities that takes place b/n the events are not specified.

Eg of pert Network



7) CPM Network is a activity oriented / based.

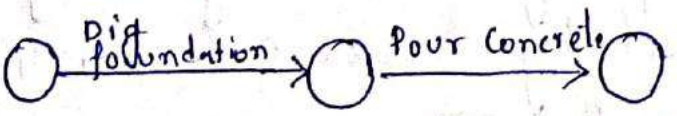
a) A CPM Network is built on the basis of Jobs or Activites.

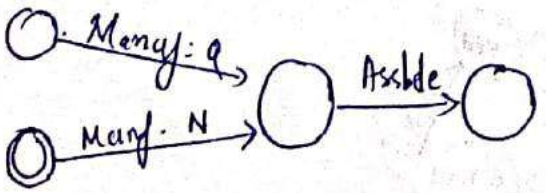
b) CPM doesnot take into account the uncertainities Involved in Estimation of time for the Excution of Job or an activity.

c) In CPM, times are realated to Costs.

With Minor Modifications ↪

Eg:





8) With Minor Modifications, both have give rise to several other programmes such as PEP [Program Evaluation procedure], LESS [Least Cost Estimating & Scheduling] SCANS [Scheduling & Control by Automated Network Systems].

9) Applications of PERT & CPM Techniques

1) In Building construction
2) It is used to making Major administrative changes in the system, for long range planning & for developing staffing plans.
3) In design, testing & Installing the Machines i.e in the Manufacturing field.
4) In Reserch & Development Sector.
5) In Installation of production & Inventory Control.
6) In Maintanence planning
7) In Marketing. : for the development & launching of new products.

Critical path.

1) The Sequence of critical activities in a network is called the critical path. The C.P is the longest path in the network form the starting event to Ending Event & defines the minimum time required to Complete the project.

2) The path reprents the sequence of activities such that it begins at the starting event & End at the final Event. The length of the path is the sum of the individal times of the activities lying on the path.

3) The critical path is denoted by double line or darker line to make distinction from the non-critical paths.

4) Main features of Critical path.

a) If the project has to be shortened, then some of the activities on that path must also be shortened.

b) The variation in actual performance from the expected activity duration time will be completely reflected in one-to-one fashion in the anticipated Completion of the whole project.

List the advantages of Network analysis over a bar Chart.

1) Network analysis can clearly shown the Interdependency b/w various diff. activity.

2) Changes in plans are necessary part of a large project, Bar Chart doesnot offer much assistence under the changes in plans. whereas in network analysis project progress can be achived by modification in Network paths.

3) Rescheduling can be made by the N.A whereas the Bar chart can't do reflect the rescheduling of events.

4) Newtork can reflet the uncertainity or tolerances in the duration times Estimated for various activity.

5) N.A Can maintain the Clear idea about Start & End activity.

6) By the network analisis we can easily find out the minimum duration of ~~find~~ achiving goal. It is self Explinatory.

7) In Network analysis we can get a better utilization of resources, Improved Communication & progress report & also got a better decision making.

8) The flexibility of the Network permits the management to make the necessary alterations & Improvements as & when needed.

Disadvantages

1) Difficulties arises in securing the realistic time, It is not suitable for new & non-repitative works.

2) Network analysis depend upon the data Input and thus the plan can be no better than the personnel who provides the data.

3) The changes made by this tecquics will be opposed by management to adopt.

4) The level of detail varies from planner to planner & depends upon the judgement & Experience of Network

5) The planning & Implementation of a network requires personnel trained technics.

Network Representation

Terminology

1) **Activity**: Performance of a specific task, operation Job or function which consumes time and resources and has a definite beginning and End is called an activity.

eg: Excavation for foundation.
laying brickwork
backfilling
trench
fix shuttering & reinforcement are activities

2) **Event**: An Instantaneous point in time marking the beginning or End of one or more activities is called an Event.

eg: Excavation Completed.
Brickwork laid
shuttering fixed
wall concreted are Events.

3) **Network**: A network is the diagrammatic representation of a workplan showing the activities step-by-step leading to Established goal. It depicts the Inter-dependence b/n the various activities i.e which activities can be done together and which activities must precede or Succeed others.

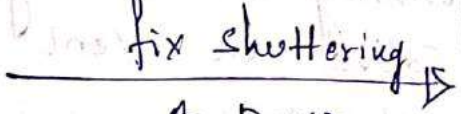
There are two methods to show the network representation

1) AOA – Activity on Arrow System
2) AON – Activity on Node System.

Activity on Arrow System.

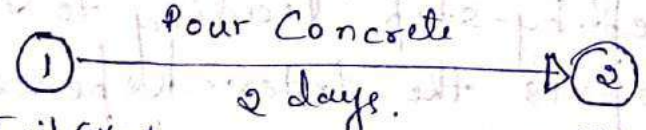
In this system an activity is Graphically represented by an arrow drawn from left to right. The discription of activity is written above the arrow and the time taken to Complete the activity is written below it.

Note: The length of the arrow bear no relationship to the duration of the activity



Representation of Activity

An event is graphically represented by a number enclosed in a circle. The beginning of an activity is marked by a tail event / preceding event and the end by head event / succeeding event.

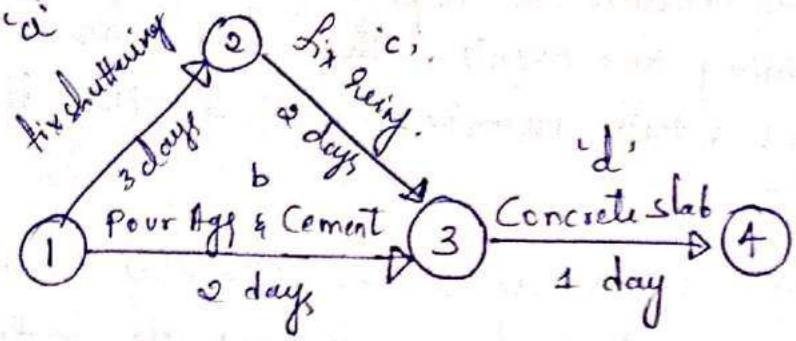


Tail Event (Preceding Event)

Head Event (Succeeding event)

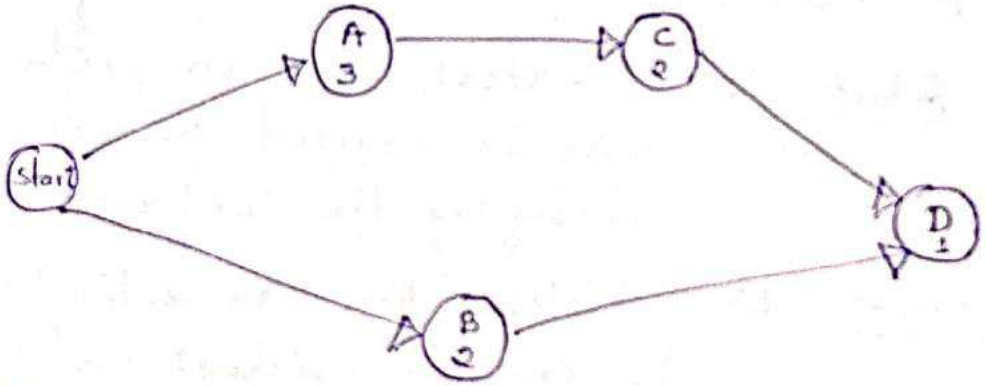
Representation of Event

Ref' of AOA system

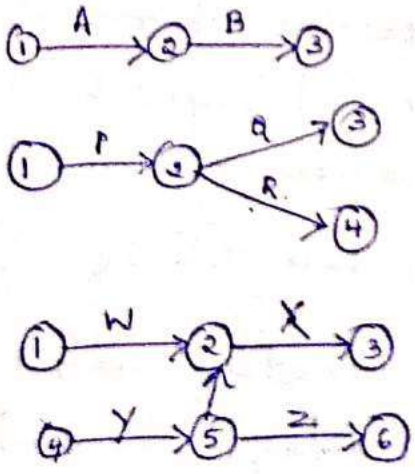


2) Activity on Node system A-O-N

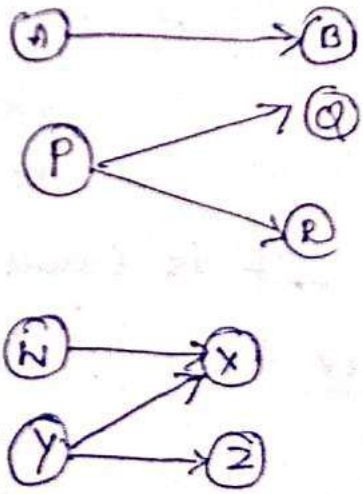
In this system activities are represented on the nodes, and arrows are used to show the dependency relationships b/n the activity nodes. The time required to Complete an activity is also Indicated in the node.



AOA



AON



Definations

ARROW : Line drawn to represent each activity in a network joining two events. The arrow is usually designated by two numbers one at the head & one at tail.

DUMMY : This is an artificial activity usually represented on the diagram by a dotted line to describe the proper relationship b/n the activities

'Early start' Es : Earliest time an activity can start

Duration D : Estimated time to Complete an activity

Early finish EF : Earliest time that an activity can be finished

$EF = Es + D.$

Latest Start LS : Latest time an activity can be started without delaying the Completion of project

Late Finish LF : Latest time an activity can be finished without delaying the completion of project.

Total float : This is the amount of time that an activity may be delayed without delaying the Completion of project

It is Equal to difference b/n LS − Es.

Free float : This is the time that a finish of the activity can be delay, the early start time of any activity. EF = Es − EF
following finish activity activity

Project Evalution and Review technique [PERT]

The main objective in the analysis through PERT approches is three time values are associated with each other.

They are 1) Optimistic time t_o

2) Most likely like t_m

3) Pessimistic value. t_p.

1) optimistic time : It is the shortest possible time in which the activity can be finished

Denoted by t_o

2) The Most likely time : It is the estimate of normal time that the activity would take. If a graph is plotted in the time of Completion and the frequency of Completion in that time period, then the most likely time will Represent the highest frequency of occurence. It is denoted by t_m

3) The pessimistic time : The Longest time that the activity Could take if Every thing goes wrong. As in optimistic time this value may be Such that only one in hundred or one in twenty will take longer than this vale. Denoted by t_p

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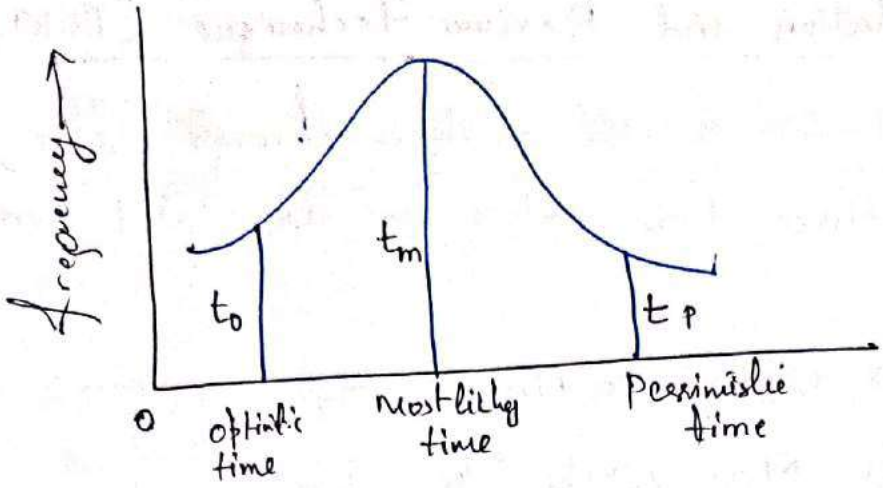
N. I. T. Devanakere - 4



Expected time : It Is the average time an activity will take if it were to be repeated on large number of times, Formula is

$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

Variance : The variance of activity is given by

$$S_t \text{ or } = \left(\frac{t_p - t_o}{6}\right)^2$$

or

$$V_t = \frac{(t_p - t_o)^2}{36}$$

or

$$\sigma = \left(\frac{t_p - t_o}{6}\right)^2.$$

Preparation of Network diagram.

Fulkerson Method for numbering events & Network.

1) A start event is the one which has arrows Emerging from it but none can entering it. Find the start event & number it as ①

2) Delete all arrows Emerging from all numbered events. This will create at least one new start Event out of preceding events

3) Number all new start Events as ②, ③ ④ --so on

4) Go on repeating steps no. 2), 3) untill the End is reached.

Advantages of Fulkerson 1-J rule

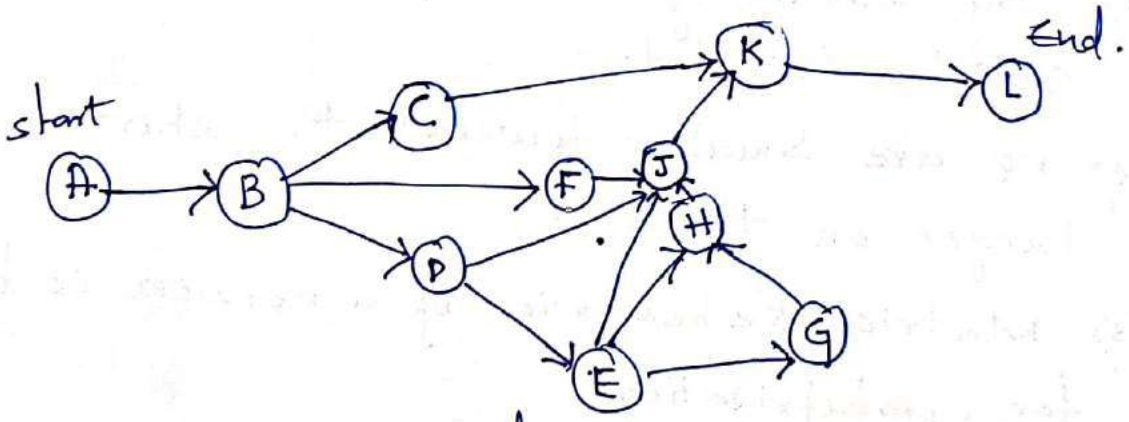
1) By Identifing close loop, an Impossible event can be detected.

2) NO are Smaller towards the start & become larger on the End

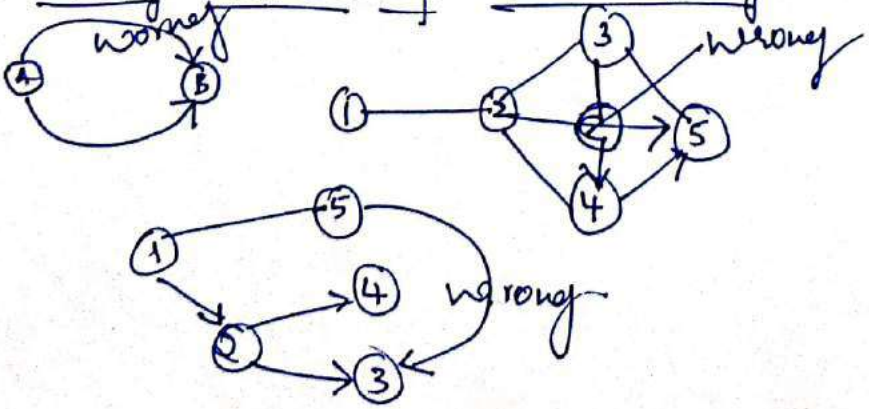
3) Matric Representation of a network is brought for Computrization.

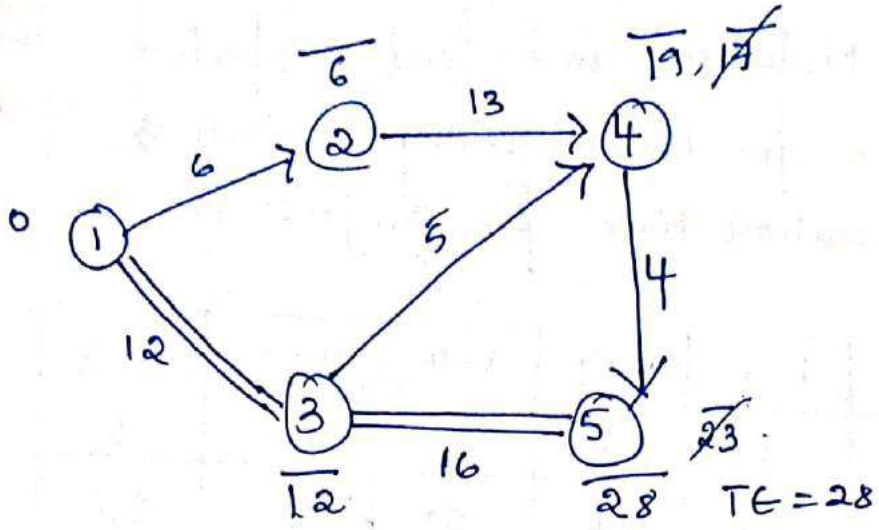
[1] Draw the Network for the following project & number the Events according to fulkersons rule.

Event number	proceed by start event
A	start
B	A
C	B
D	B
E	D
F	B
G	E
H	G, E
J	D, F, H, E
K	C, J
L	K.



Note : Wrong Methods for Networking.





$$Z = \frac{38 - 28}{S.D.}$$

$$S.D = \sqrt{9 + 16} = \sqrt{25} = 5.$$

$$Z = \frac{38 - 28}{5} = 0.8.$$

[3] The following table shows the activities and their time Estimates

a) Draw the Network & find the Expected length

b) what is the probality of completion in 48 days

c) what is the varience of project length.

Activity	10-20	20-30	20-40	30-50	40-50	40-60	50-70	50-80	70-90	20-90	60-100	90-100
t_o	4	1	8	3	0	3	3	4	4	2	4	4
t_m	8	4	12	5	0	6	6	6	8	5	6	10
t_p	12	7	16	7	0	9	9	8	12	8	8	16.

[2] Draw the Network and find Expected duration and Variance for the following activities If the Expected duration time for project is 32 days

Activity	1-2	1-3	2-4	3-4	4-5	3-5
t_o	2	3	5	2	1	6
t_m	5	12	14	5	4	15
t_p	14	21	17	8	7	30

Activity	t_o	t_m	t_p	t_e	S_t	V_t
1-2	2	5	14	6	2	4
[1-3]	3	12	21	[12]	3	[9]
2-4	5	14	17	13	2	4
3-4	2	5	8	5	1	1
4-5	1	4	7	4	1	1
[3-5]	6	15	30	[16] CP	4	[16]

Formula t_e = Avg. time = $\frac{t_o + 4t_m + t_p}{6}$

$S_t = \frac{t_p - t_o}{6}$

$V_t = \left(\frac{t_p - t_o}{6}\right)^2$

$Z = \frac{D - T_E}{S.D}$

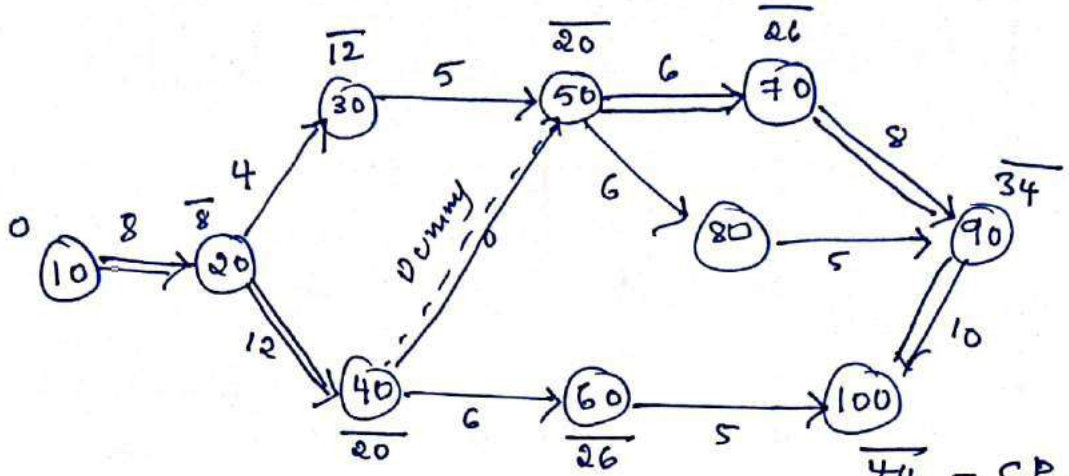
D = project time

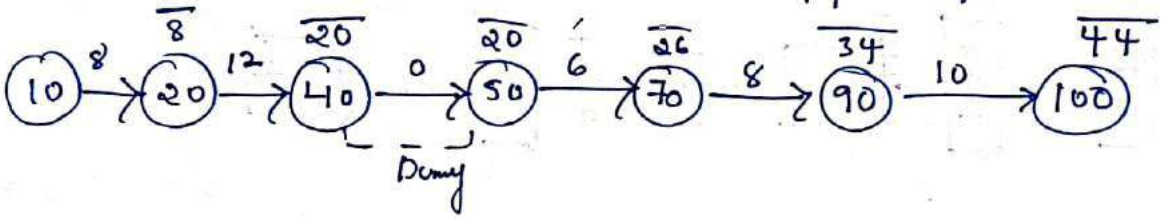
T_E = CP time. = final time in network

S.D = $\sqrt{\text{Variance}}$

$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

Activity	t_o	t_m	t_p	t_e	S_t	V_t
10 – 20	4	8	12	8	1.33	1.78
20 – 30	1	4	7	4	1	1
20 – 40	8	12	16	12	1.33	1.78
30 – 50	3	5	7	5	0.66	0.44
40 – 50	0	0	0	0	0	0
40 – 60	3	6	9	6	1	1
50 – 70	3	6	9	6	1	1
50 – 80	4	6	8	6	0.66	0.44
70 – 90	4	8	12	8	1.33	1.78
80 – 90	2	5	8	5	1	1
60 – 100	4	6	8	5	0.66	0.44
90 – 100	4	10	16	10	2	4





C.P = 44. = ~~8+20+20+26+34~~

8 + 12 + 0 + 6 + 8 + 10 = 44

S.D = $\sqrt{\text{variance}}$

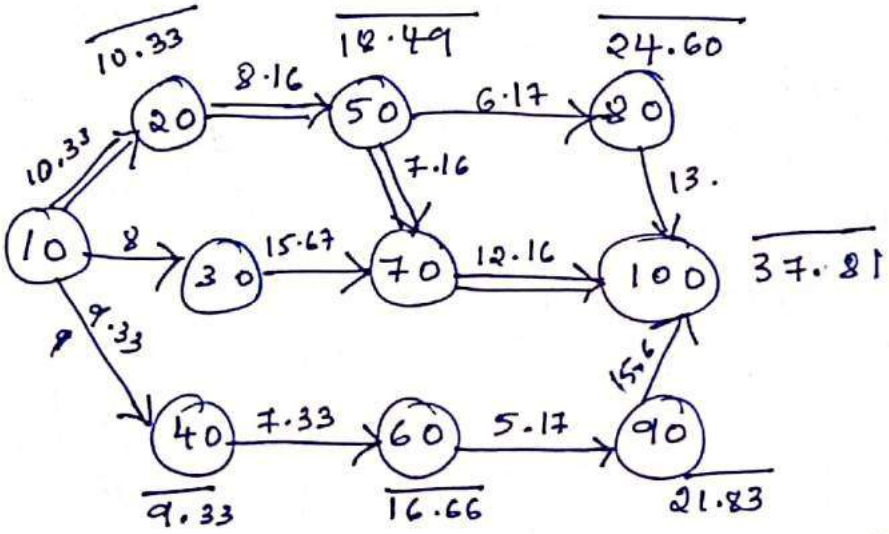
= $\sqrt{1.78 + 1.78 + 0 + 1 + 1.78 + 4}$

S.D = 3.21

$Z = \frac{D - CP}{S.D} = \frac{48 - 44}{3.21} = 1.24$.

4 Probability Completion in 60 days.

Activity	to	tm	tp	te	St	Vt
10-20	8	10	14	10.33	1	01
10-30	6	8	10	8	0.66	0.44
10-40	7	9	13	9.33	1	1
20-50	6	8	11	8.16	0.83	0.69
30-70	12	16	18	15.67	1	1
40-60	6	7	10	7.33	0.66	0.44
50-80	3	6	10	6.17	1.16	1.36
50-70	5	7	10	7.16	0.83	0.69
60-90	3	5	8	5.17	0.83	0.69
70-100	7	12	18	12.16	1.83	3.36
80-100	10	13	16	13	1	1
90-100	13	15	21	15.67	1.33	1.78.

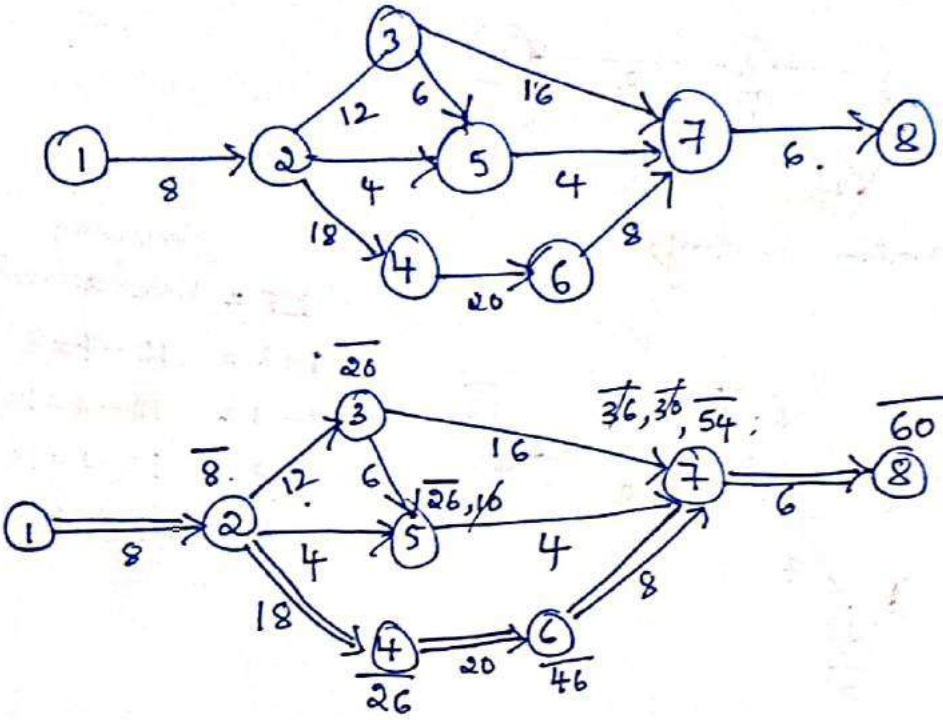


10 —10.33→ 20 —8.16→ 50 —7.16— 70 —12.16→ 100 CP = 37.81

$$SD = \sqrt{1 + 0.69 + 0.69 + 3.36} = 2.39$$

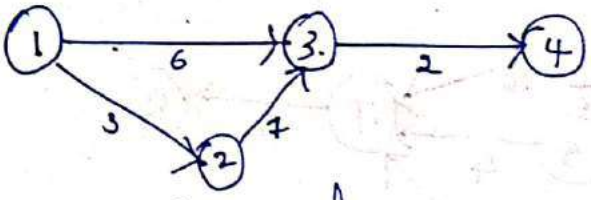
$$Z = \frac{D - TE}{S.D} = \frac{60 - 37.81}{2.39} = 9.276.$$

Identify the Critical path in the network and determine project Completion time.



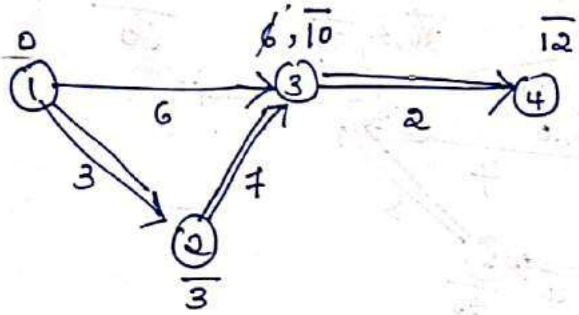
Activity Adi	Duration in days D	Earliest Time start ES	Earliest Time finish EF=ES+D	Latest time start LS=LF-D	Latest time finish LF=Head event − D.	Total float TL = LF-EF or LS-ES	Remarks.
1-2	8	0	8	0	8	0	CP
2-3	12	8	20	26	38	18	—
2-4	18	8	26	8	26	0	CP
2-5	4	8	12	46	50	38	—
3-5	6	20	26	44	50	24	—
3-7	16	20	36	38	54	18	—
4-6	20	26	46	26	46	0	CP
5-7	4	26	30	50	54	24	—
6-7	8	46	54	46	54	0	CP
7-8	6	54	60	54	60.	0	CP.

Determine the project Completion time & Critical path for the network shown in fig.



Duration in days.

$\Longrightarrow$



Succeeding
~~Preceding~~

LF = Head activity − D

1-2 = 10 − 7 = 3

1-3 = 12 − 2 = 10

2-3 = 12 − 2 = 10

3-4 = 12 − Last activity

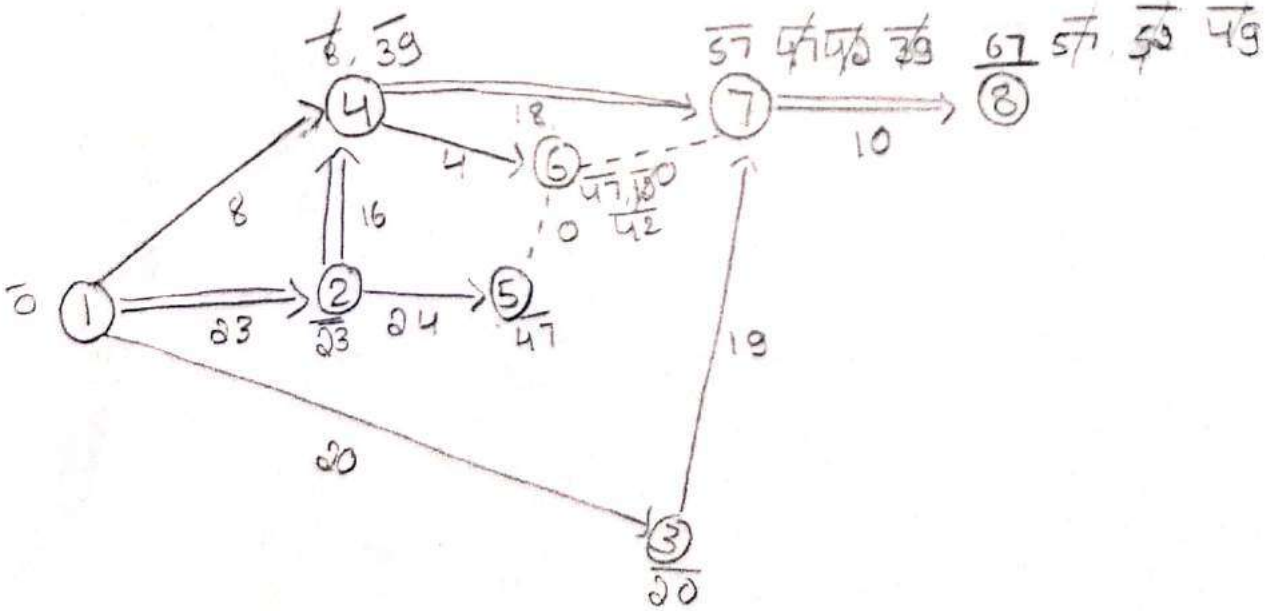
CP → 1-2, 2-3, 3-4

Project compl^{n} time 3 + 7 + 2 = 12

Activity	Duration	Earliest Time start ES	Earliest Time finish ES + D = EF	Latest Time start LS = LF − D	Latest Time finish LF = Head − D	Total float TF = LF − EF or LS − ES	R
1-2	3	0	3	0	10-7=3	0	CP
1-3	6	0	6	10-6=4	12-2=10	10-6=4	—
2-3	7	3	10	10-7=3	10	10-10=0	CP
3-4	2	10	12	12-2=10	12.	0.	CP.

Find out the earliest start and earliest finish and plot the network for following

Act	duration	Earliest		latest		Total float
		start	finish	start	finish	
1-2	23	0	23	0	23	0
1-3	20	0	20	18	38	18
1-4	8	0	8	31	39	31
2-4	16	23	39	23	39	0
2-5	24	23	47	83	47	0
3-7	19	20	39	38	57	18
4-6	4	39	43	53	57	14
4-7	18	39	57	39	57	0
5-6	0	47	47	57	57	10
6-7	0	43	43	57	57	10
7-8	10	57	67	57	67	0



C-P 0-2, 2-4, 47, 7-8

Module-2

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Resource Management Manpower.

Basic Concepts of resource management, class of labour, wages & statutory requirement, labour Production rate or productivity, factors affecting labour output or productivity.

Construction Equipments : classification of Construction Equipment, Estimation of productivity for Excavator, dozer, Compactors, graders, pavers, dumpers, transit mixer and plants, selection of Construction Eqpt. and basic concept on matching Equipments, methods of Calculating depreciation, replacement model concept of maintenance of plant & machinery.

Materials : Material Management functions
Inventory management.

Resource Management : RM is the process of planning the resources necessary to meet the objectives of the project and to satisfy the client's Requirements.

Without proper resource Management, project can fall behind schedule or can become unprofitable The obejective is to Ensure the adequate and timely supply of resources, at the same time maximising the utilisation of resources b/n the project.

Fundamental to resource Management is real time visibility of

↳ What resources are available
↳ where resources are located
↳ Ability to reschedule those resources.

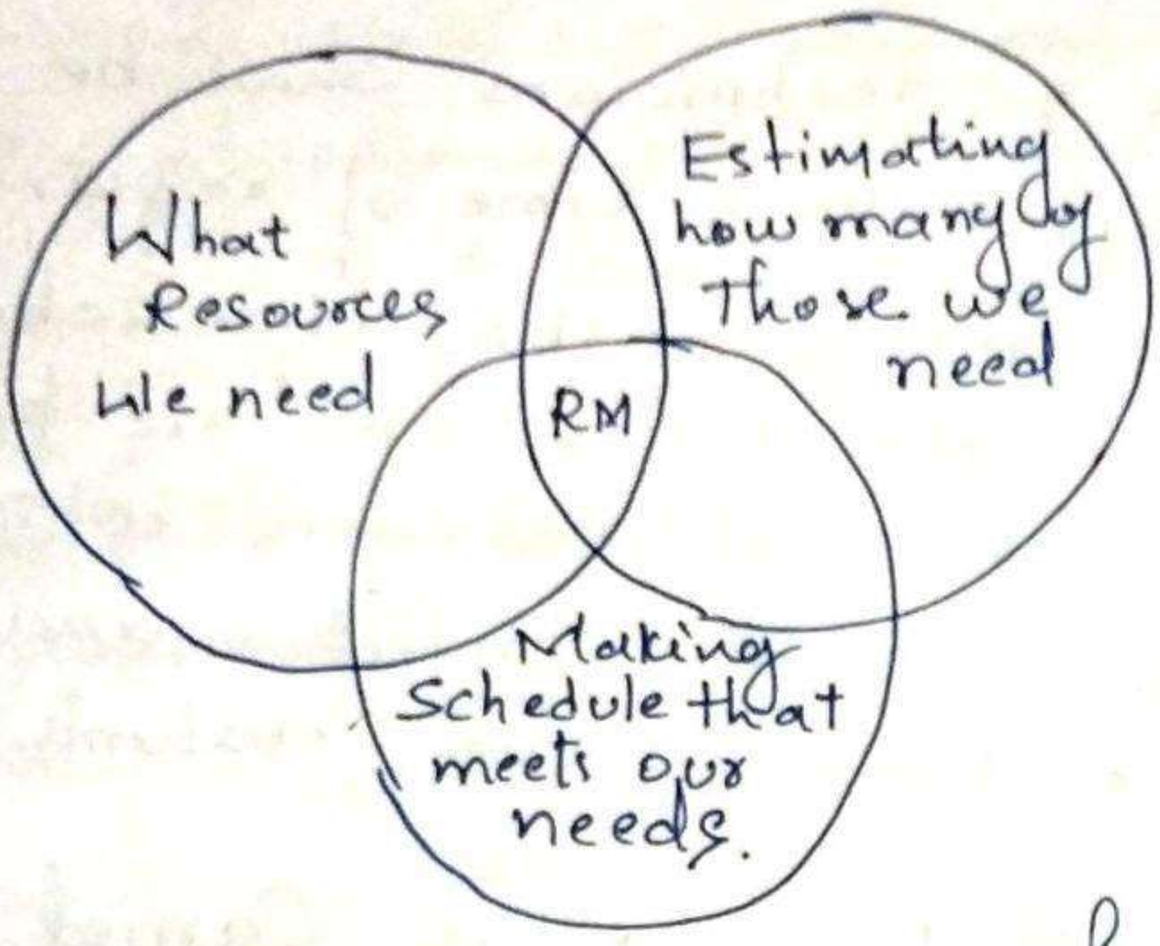
Construction resources Include

↳ products & Materials
↳ Const^n plant, tools & Equipment
↳ Human Resources
↳ space & facilities.
↳ subcontractors
↳ Finance.

Uses of Resource Management plan.

1) Ensure Resource aviliablity & resolve resource Conflicts.
2) optimise time, effort & Cost
3) Ensure workers with the right skills.
4) Identify limitations, such as site acces weather Conditions & Soon..
5) Reassign resources in response to Circumsta
6) Track resources utilisation to avoid Excessive Resourcing or under Utilisation.
7) Access to up-to-date project plan
8) understand type of resources that are need
9) Make use of potential for developing recou for new use.

Resource Management



RM system can Improve Companies overall efficiency replacing less efficient data collection methods such as paperforms spreedsheets & so on.

Construction Companies face the Challenge of delivering often complex projects to a schedule within a budget and hopefully with a reasonable profit margin.

Work plan in making Resource Mgt.

1) Access to the up-to-date project plan with clear definition of different phases of work and activity scheduling.
2) Understanding the types of resource that are needed
3) Understanding the availability & optimum utilisation of resources.
4) Understanding potential for developing resources for new uses
5) Understanding Lead time required to ensure that resources are available when needed
6) Ability to redeploy resources if works need to be accelerated or if works are Completed.

Manpower Resources

Man power Resources under the Categories of Construction workers & technicians shall be planned for their Quantities, skills & time of requirement based on the project details, WBS, time schedule and Estimates. Resource histograms are prepared for different Categories of workforce which can be done by using standard project management software with in built labour Constants.

Resource levelling shall be Carried out to sort out the peak demands Exceeding the Resource availability and also to resolve idle labour situations by rescheduling Certain activities within the availability floats without delaying Project Complition time. planning shall be done to take care of any situation in case of non-availability of local labour force necessitating Import from other locations as in Case of projects in remote areas.

Labour Class (Working Class)

Introduction:

'LABOUR' is nothing but a work and especially a physical work. And the one who performs this is known as Labourer or a Worker.

A labourer or a worker is a person who works in one of field in which he has knowledge. Considering our Civil field a worker too could be called as a Construction Worker, he is a term person or professional employed in the physical construction of the built environment and its infrastructure.

Or

A labourer could also be defined as the one who uses his body strength instead of intellectual power to earn a liv

Class of labourer or a Worker:-

Groups of working individuals are typically classifie based on the colors of their collars work at work; these can com ufluct one's occupation or Sometimes gender too.

The can be classified as shown below:-

- White collar Worker
- Blue-collar Worker
- Green-collar Worker
- pink collar worker.

are some of the main classifications done on w

hite-Collar Worker:-

The term "white-collar Worker" was coined in 1930's b pton Sinclair, an american writter who refrenced the word in -o clerical administrative and managerial functions. A white c

worker is a salaried professional, typically suffering to general office workers and management. However, in certain developed countries like the United States, UK & Canada, a person is assumed to be a white collar worker when one engages in a highly professional & successfull carrier or works in either an administerative or managrial role. (Teaching)

* Blue-collar worker:-

He is member of the working class who performs manual work and either earns an hourly wage or is paid piece rate for the amount of work done. This term was first used in 1924.

It involves skilled or unskilled manufacturing, mining, sanitation, custodial work, oil field work, construction, mechanic, maintenance, warehousing firefighting, technical installations and many other types of physical work. Often something is physically being built or maintained. And most of the blue-collared workers are found wearing durable clothing to protect themselves from harm at the work places. And they are the one who have maintain occupational health and safety at the places.

* Green-collar Worker:-

He is a worker who is employed in environmental sectors of the economy. Environmental green collar Workers satisfy the demand for green world development. generally they implement environmentally conscious design, policy and technology to improve conservation and sustainability. Formal environmental regulations as well as informal social expectations are pushing many firms to seek professional expertise with environmental, energy efficency and clean renewable energy issues. They often seek to make their output more sustainable and thus more favourable to public opinion, governmental regulation & the earth's ecology.

Green collar workers include professionals such as conservation movement workers, environmental consultants, environmental scientists, council environmental Services / waste management / recycling managers / officers, environmental or biological systems engineers, green building architects, landscape architects, holistic passive solar buildingengineers, green vehicle engineers, green business owners, organic farmers, environmental lawyers, ecology educators & ecotechnology workers.

Pink-collar Workers;

His He is also a member of working Class who performs in the service industry. They work in positions such as waiters, retail clerks, salespersons and many other positions involving relations with people. The term was coined in late 1990's as phrase to describe jobs that were typically held by women; now the meaning has changed to encompass all service jobs.

Other job classes:

Gold collar: Highly skilled professionals who may be in high demand such as chartered accountants, surgeons, anesthesiologists, engineers & lawyers.

Red collar: Government workers (all type)

Grey collar: Skilled technicians (combinations of blue & white co

They principally white collars, but when situati

knock they have to perform the abilities in work to g

or may be anything.

No-collar: Artists, poets, who tend privilege their passion.

Orange collars: prission laborers

Scarlet Collar: Workers in Sex-industries (adult)

Black collar :- Manual clabours, in which they become toodiety; oil drilling, mining, waste treatments etc..

Virtual collar: Robots.

So is all about workers and their classes.

Labor Wages.

India introduced many of Minimum Wages act in respective years almost every year we can get an act on clabour wages on its increments of decrements, and I dont think there would be any decruments.

Both Central gourment and State gouvernment (decides) jurisdiction in fixing wages. The acts are legally non-binding, but Statutory. Every labour should be paid with minimum wages fixed by the wages boards of gouvernment, if not it could be illegal.

And the wages should atleast cover a four requirements of a family. they are
- Calories (food)
- Shelter
- Clothing
- Education
- medical assistance
- Entertainment.

The wages varies from
- states to states
- Sectors
- skills
- regions
- occupations he is in ...
- cost of living
- Patterns etc..

Hence there is no single uniform of wage rates across the country.
Ex: Delhi 332/day, Tripura 38/day... My friend want to give another perspective on this topic.

2.2 CLASS OF LABOUR

Construction labour can broadly divided into two types

1. Casual labour
2. Regular establishment

Casual labour: Casual labour is employed as and when required for the execution of work, payment is made on the basis of the number of days the labour works. There is no provision of leave, except the weekly holidays. This is also known as daily labour.

Regular Establishment: Regular establishment generally includes supervisory personal that are required for more or less continuous period during construction. They are paid monthly wages and entitled to leave and other benefits. The employees may be temporary or permanent. Permanent employees have great security of service and may be entitled to more service benefits than the temporary employees.

2.3 WAGES & STATUTORY REQUIREMENT

2.3.1 PAYMENT OF WAGES

The remuneration given to workers for work performed by them is known as wages. Wages are of two types.

1. **Nominal wage:** This is the remuneration paid to the worker in the form of money, but it does not include the value of any other benefit that may be provided.
2. **Real Wage:** Labour is often entitled to different benefits, such as leave, medical care, house rent allowance, bonus etc. If the value of such benefits is added to the nominal wage, it is known as real wage.

Wages are paid to the labour based on two methods:

1. Depending upon time devoted to the work. This method is known as time rate system.
2. Depending upon the quantity of work performed. This method is known as piece rate system.

The minimum wages payable as per contract labour and regulations act -1970 are periodically revised by labour authorities and the latest version of approval labour rates for payment for ensuring minimum wages shall be strictly adhered too. All labour payments shall be made in presence of the authorized representative of the principal employer.

2.3.2 MINIMUM WAGES ACT, 1948

The Minimum wages Act of 1948 was passed for the welfare of labour and provided for fixing the minimum rate of wages of labour. The Act aims at making provisions for the statutory fixation for the minimum rate of wages in number of industries where there are extensive chances for the exploitation of labour.

The main provisions of Minimum wages Act are:

1. The setting of advisory committees to collect information on which the minimum wages are based.
2. The wages of a worker in any scheduled employment shall be paid on a working day by:
   (i) The 7th day after the last day of the wage period if the establishment has less than 1,000 employees.
   (ii) The 10th day after the last day of the wage period if establishment has more than 1,000 employees.
3. The wages of an employee should be paid without any deductions except those items given below.
   (i) Fines in respect of acts of omission.
   (ii) Absence from duty.
   (iii) Loss of goods directly attributed to the neglect of the employee.
   (iv) House accommodation provided by the employer.
   (v) Amenities and services provided by the employer.
   (vi) Income tax
   (vii) Subscription to the provident fund.
   (viii) Recovery of advances.
   (ix) Deductions ordered by the court.
   (x) Payments to co-operative societies / Life Insurance Corporation.

2.3.3 WORKMEN COMPENSATION ACT, 1923

The Workmen Compensation Act passed to protect the victims of accidents and their families from hardships out of and in the course of employment. The Act covers workers employed in hazardous occupations as specified in the schedule but excludes those employed in clerical or administrative work. The Act provides for payment of compensation in case of accidents on work sites. The compensation, however, is not payable for injuries due to

(i) Disobedience or negligence.
(ii) Non observance of safety measures
(iii) consumption of liquor
(iv) diseases which are not contracted as a result of the occupation.

In the case of the death of a worker, compensation is paid under all circumstances.

Accidents are due to

(i) Human causes such as poor eye sight, negligence, effect of intoxicants,
(ii) Mechanical causes such as inadequate safety devices, live electrical equipment, unreliable scaffolding etc.
(iii) Environmental causes. Such as poor lighting, heat, noise etc.

The result of an accident may be:

1. Temporary disablement, which may be total or partial.
2. Permanent total disablement.
3. Permanent partial disablement.
4. Death.

The Compensation to be paid is depends on the result of the accident. The Act provides for the appointment of Commissioner for the quick disposal of claims for compensation. The employers are required to notify fatal or serious accidents to the commissioner within seven days. Civil courts are debarred from considering cases rising out of the Act and these are under the jurisdiction of the commissioner.

2.3.4 CONTRACT LABOUR ACT, 1970

The contract labour Act, 1970 was passed to regulate the employment of contract labour in certain establishments. It also provides for improving the service conditions of contract labour.

The Act is of importance to the construction industry where works are executed through contractors or by contract labour. The Act applies to every establishment and contractor employing twenty or more workmen. The Act does not apply to establishments in which only work of an intermittent or casual nature is performed.

The Act provides for the constitution of a Central Advisory Contract Labour Board under the Central Government and of state Advisory contract labour Board under each State Government to advise the Central and State Governments on matters arising out of the administration of the Act and to carry out the functions assigned to it under the Act.

The main provisions of the Act are:

1) **Registration of Establishments:** Every principal employer of an establishment to which the Act applies is required to make an application to the registering officer on the prescribed form for the registration of the establishment.

2) **Licensing of Contractors:** Every contractor executing any work through contract labour is required to obtain a license.

3) **Welfare and Health of Contract Labour:** Under the Act, the following facilities are required to be provided for the welfare and health of the contract labour:
   (i) For works likely to continue for more than three months, where labour is required to halt at night in connection with the working of the establishment, the contractor should provide rest rooms. Separate rooms should be provided for women.
   (ii) For works likely to continue for more than six months and employing more than 100 or more labour, an adequate canteen should be provided.
   (iii) Latrines and urinals must be maintained in clean and sanitary conditions.

4) **Payment of wages:** Responsibility for the payment of wages rests upon the contractor.

Labour production rate or productivity.

Labour productivity is a measure of economic growth within a Country. Labour productivity measures the amount of goods & services produced by one hour of labour. [GDP]

↓

Gross domestic product.

Labour production rate depends on

↳ Investment

↳ New Technology

↳ human Capital.

$$\text{Productivity} = \frac{\text{output}}{\text{Input}}.$$

$$P = \frac{\text{Total output}}{\text{Total work hour}}.$$

3 different Measures of productivity.

1) Economic Model

$$\text{Total Factor productivity (TFP)} = \frac{\text{Total output}}{\text{Labour + Material + Equipment + Energy + Capital.}}$$

2) Projed Specific Model

$$\text{Productivity} = \frac{\text{output}}{\text{Labour + Material + Equipment}}$$

3) Activity Oriented Model

$$\text{Labour productivity} = \frac{\text{output}}{\text{Labour Cost}} \quad \text{or} \quad \frac{\text{output}}{\text{work hour}}.$$ //

Importance of Measuring Labour productivity.

↳ labour productivity is directly linked to Improved standards of living in the form of higher Consumption.

↳ As a Economy's labour productivity grows it produces more goods and Services for the same amount of relative work.

↳ Growth in labour productivity is directly attributable to fluctuations in physical Capital new technology & human Capital. If L.P is growing it can be traced back to growth in one of these three areas.

↳ Labour productivity is also Important to measure of short term & Cyclical Changes in an Economy.

→ High level labour productivity is a Combination of total output and labour hours. Measuring labour productivity at each quarter allows an economy to measure the Change in its labour hours.

Conclusion: If output is Increasing while labour hours remains stable, it Could be a Sign that the economy is advancing technologically and should Continue to do so. Conversely, if labour hours Increases in relation to flat output, it may be a Sign that the Economy needs to Invest in education to Increase its human Capital.

Factors affecting labour output or productivity.

1) Labour Supervision
2) Skilled labour
3) Scheduling of work
4) Training of labour
5) payment
6) Communication b/n the site Mgt & labour
7) Climatic Condition.
8) Expectations out of Labour performence
9) Unscheduled Extra work
10) Construction Method
11) Availability of Material
12) Incentives schemes (Payment for Extra work)
13) Availability of tools
14) Numbers of labours on site
15) site layout.
16) Facilities provided to labour
17) Temperature on site.
18) Material storage location
19) Structural Design
20) Safety Conditions on Site
21) Meetings with labour Contractor
22) Motivation to labour
23) project Manager's leadership.
24) Miscommunication b/n site Management.
25) Health and Saftey factor

Guidelines for Improving Labour productivity.

1) proper trainings to Labours
2) Motivation to workers towards project Completion.
3) properly and In advance material procurement and Management.
4) on time payment to the Workers.
5) Systematic flow of work
6) properly, clearly & in time Supervision
7) Advance site layout.
8) Maintain Work disipline.
9) Facilities to the labour.
10) Clearence of legal documents before starting work.
11) systamatic planning of funds in advance.
12) pre-mansoon plan to avoide Work stop
13) Maximum use of Machinery & automation System
14) Advance Equipment planning.

Construction Equipments

Construction Machines on every Construction sites which make the Construction job easy, safe & Quicker Good project management in Construction must require efficient utalisation of labour, material and Equipment. The use of new Equipment & Innovative methods has made possible Changes in Construction technologies in recent decades. The use of appropriate type and size of Construction Equipment often affects the required amount of time & effort and thus Job site productivity of a project. About 15-30% of total project cost has accounted towards Equipment & machinery. Therefore it is Important for site managers & Construction planners to be familiar with the characteristics of Major type of Equipments most Commonly used in Construct

Advantages of utalising Construction Equipments.

1) Increase rate of output with effective & Efficient method
2) Reduce overall Const^n Costs for large projet
3) Carry out activites Economically & much faster which cannot be done manually.
4) Eliminate heavy manual work by human thus reducing hazards & helth Issues
5) Maintain planed Rate of production
6) Maintain the high Quality standerds often required by present day design & tecnical specif

Classification of Construction Equipments

Const^{n} Equipment Industries

Earth Moving Equipment

- Excavators
- Backhoe
- Loaders
- Bull Dozers
- Skid steer Loaders
- Trenchers
- Motor Graders
- Motor Scrapers
- Crawler Loader
- Wheeled Loading Shovels

Construction vechicles

- Dumpers
- Tankers
- Tippers
- Trailers

Material Handling Eqft

- Cranes
- Conveyors
- Forklifts
- Hoists

Construction equipment

- Tunneling & Handling Equipment
- Road rollers
- Concrete mixers
- Hot mix plants
- Road making machines (Compactors)
- Stone crushers
- Pavers
- slurry seal machines
- Spraying & plumbing machines.
- Heavy duty pumps.

① Earth moving Equipments

a) Earth Cutting & moving Equipments

→ Bulldozers, Scrapper, front end loader

b) Excavation & lifting

→ Back hoe, power shovel, Dragline, Clamshell

c) Loading Equpts

→ Loaders, Shovels, Excavators.

d) Transportation Eqpts

→ Tipper, Dump truck, Conveyor

e) Compacting Equipments

→ Rollers ← sheep foot
smooth wheel
Pneumatic type

② Concrete plant & Equipment.

a) production Equipments

→ Batching plant & Concrete mixers

b) Transportation Equipments.

→ Truck mixers, Concrete dumpers.

c) placing Eqpt.

→ Concrete pump conveyors, hoist & Grouting Eqpts

d) Concrete vibrating Equipments

→ Needle Vibrator and plate Compactor.

③ Hoisting Equipments.

a) Hoists
→ fixed, mobile & fork lift

b) Mobile cranes
→ Crawler mounted, self propelled, rubber tyred, truck

c) Lower Cranes
→ stationary, travelling type cranes

④ Special purpose / Heavy Const.ⁿ plant & Eqpt.

a) Aggregate production Equipments
↳ crushing plants, Screening plants & rock blasting Eqpts.

b) pile driving Equipments.
→ pile driving hammers

c) Concrete paving Equipments.
→ Concrete pavers & finishers.

d) Tunneling Equipments
→ Drill jumbo, rock blaster & tunnel boring machin

⑤ Support and utility service Equipments
It Consists of geneeators, welding Eqpts
Pipe laying Eqpts, pumping & dewatering Eqpts.

Estimation of productivity.

① **Excavator** : Excavators are heavy Contruction Eqpt. Consisting of a boom, stick, bucket & Cab which performs the functions like digging, moving & trasporting.

Output of Excavators.

Hourly production in m^3/hr

$$Q = q \times \frac{3600}{C} \times \text{Efficiency}$$

Where q = production per cycle. $(m^3) = q_1 \times s \times k$

C = cycle time (Sec) = Excavating Time + S & BS Time + Dumping Time

q_1 = Heaped Capacity as per specifications of Excavator

s = Swell factor

k = Bucket fill factors.

(It is Considered b/n 0.4 to 1 depending upon digging and loading conditions)

Cycle time C: is the time required for → Excavation
→ Swing & backswing
→ dump

↳ Excavating time depends on digging depth & surface to be digged.

↳ Swing time depend on degree & speed of Swing and the skill of operator.

↳ Dumping time depends upon the proper spoting of vehicle & skill of the operator.

K : Bucket fill factor, depends on the material to be Excavated. following table indicates the B F. factors for diff. materials.

Material	K
1) soft clay.	1 to 1.1
2) Earth & loam	0.9 to 1.05
3) Bank gravel & Sand	0.9 to 1
4) uniform aggregates	0.8 to 0.9
5) Hard clay.	0.75 to 0.85
6) Rock	
→ well blasted	0.60 to 0.75
→ Coarsely blasted.	0.4 to 0.6

Swell factor S : Loosening of earth causes an increase in volume, which is Expressed as a % of original undistrubed volume gives the percentage of swell earth.

The Ratio of volume of original earth to the loose earth is known as swell factor

oose volume handled / trip = production per cycle.

= Blade width X (Blade ht)^2 X Blade factor

↓

range. (0.4 to 1.1)

② **Dozer** : Dozers are the equipment designed primarily for cutting and pushing the material over relatively short distances. They consists of a tractor with a front mounted blade controlled by hydralic cylinders to vary the depth of cut and rate of levelling depending on the material & application.

The production of dozer mainly depend upon the following factors

a) Size & condition of the dozers
b) Distance travelled by the bulldozer
c) speed of operation
d) Characteristics of soil being handled.
e) Surface on which dozer is operated.
f) Efficiency of dozer.

out put of dozer — in bank-volume/hr

output Q = Loose vol. handled/trip $\times \frac{S}{} \times \frac{60}{t} \times$ efficiency

S - Swell factor D/F D/R G.

t = cycle time = Push time + Return time + Maneuvering time
min min min.

↓

(Time req./trip) in min.

$t = \frac{D}{F} + \frac{D}{R} + G$ → Gear shifting time (min)

where D = Haul distance (m), F - forward speed (m/min)
R - Reverse speed (m/min).

(3) Compactor: A Compactor is a machine or mechanism used to reduce the size of material such as waste material & bio mass through Compaction. A Road roller (Roller Compactors) is a type of Engg vehicle used to Compact soil, Gravel, Concrete or asphalt in the Construction of roads & foundations.

Selⁿ depends on site Conditions & type & size of Compactors matched with type & output of carrying equipments (truck, dumper or scrapers, grader & paver).

Capacity of Compactor in two ways.

1) Surface capacity - (By neglecting thickness of layer)

$$Q = C \times \frac{W \times S \cdot 1000}{P} \quad m^2/hr.$$

2) Volumetric Capacity (Including thickness of layer)

$$Q = C \times \frac{W \times S \times T \times 1000}{P} \quad m^3/hr.$$

Where. Q = output in m^2/hr

W = Drum width, in metres

S = Avg. Compaction speed in km/hr.

P = No of passes (calculated by Considering forward and return travel as two passes)

C = Efficiency factor / site operating co-eff.

It Includes repair, Inspections, breaks, overlaps & other factors effecting Eff

generall C = 0.8 - Excellent Conditions
0.7 — under good Conditions
0.6 — under fair Conditions.

T = Layer thickness after Compaction in (mtrs)

④ Graders : Graders are used for levelling and smoothening the earthwork, spreading & levelling the base course in the construction of roads and airfields. It can also be used for land reclamation snow clearence, gravel road repairing. mixing of stabilized materials such as tar, asphalt, cement & lime, maintaining quarry roads etc.

productivity of Motor Grader depends on
↳ size & mechanical condition of Grader
↳ size of blade ↳ speed of travel ↳ soil nature
↳ Efficiency of the operater.

out put of Grader is indicated by Area Covered by Grader per hr

Area covered by Grader /hr = Effective width of blade × Avg. speed × Efficiency

Time required to Completing a particular job can be Calculated by

$$\text{Time to Complete Job (in hrs)} = \frac{\text{No of passes} \times \text{Distance in Kms}}{\text{Avg. speed in Km/hr} \times \text{Efficiency factor}}$$

Note : Eff. width of blade is when the blade is at an angle, it should be the width actually Covered by machine

Efficiency = 40 to 50 min/hr — working efficiency

eff. factor = 0.7, which means the effective work the grader does it work in about 42 min in an hr.

(5) <u>Pavers</u> : A paver (Paver finisher, asphalt finisher paving machine) is a piece of Constn Eqpt used to lay asphalt on roads, bridges, parking lots & other such places. It lays the asphalt flat and provides minor Compaction before it is Compacted by a roller.

<u>Calculation of laying rate</u> : higher the paving speed, Greater the thickness and more the width, the Greater will be the quantity of material passing through the paver during a given time & vice versa.

The following formula made Quick calculations about quantity of material required per hour for a given width & thickness of mat.

$$Q = W \times \frac{T}{100} \times S \times D \times 60$$

Where Q = Quantity of material required in kg/hr
W = Mat width in meters
T = Mat thickness in Centimeters
S = Working speed in met/min
D = Material weight in kg/cum.

using Same formula the working speed to suit the given rate of material supply can be Calculated.

$$S = \frac{Q \times 100}{W \times T \times D \times 60} \text{ meters/min}$$

⑥ Dumpers : Dumper is a Vehicle designed for Carrying bulk material, often on building sites. Dumpers are distinguished from dump truck by a Configuration ; a dumper is usually an open 4 wheeled Vehicle with the load skip in front of the driver, while the dump truck has its Cab in front of load.

Dump trucks are open vehicles which are Capable of Carrying and dumping earth, aggregate or other loose material to Construction sites on various projects such as dams, highways, ports etc.

Estimation of Hauler production for dumpers

$$\text{Hauler production per hr} = \frac{60 \text{ min}}{\text{Time required to Complete one cycle in (minutes)}} \times \text{Hauler's payload per cycle in (Tonnes or Cu-m or kg.}$$

Payload : The term rated payload is the maximum recomended load for a hauling unit as prescribed by Manufacturer. three ways of measuring haulage vehicle payload.

i) Rated Capacity in kilograms of payload
ii) Struck Capacity measured in cubic mts
iii) heaped Capacity (3 : 1 slope) in cubic-mts.

$$\text{Haulers pay load (Rated capacity) of Earth Bank wt.} = \frac{\text{loose } m^3 \text{ material}}{\text{swell factor.}}$$

$$\text{where swell factor} = \frac{100}{100 + \text{percentage of swell.}}$$

Cycle time: Each cycle time of hauler's operation Consists of
i) loading time
ii) Hauling time
iii) Dumping & turn time
iv) Return time
v) spotting & waiting time.

When adding all this time, it constitutes one cycle.

$$\therefore \text{Cycle time} = \underset{\text{Time}}{\text{Lodly}} + \underset{\text{Time}}{\text{Haulip}} + \underset{\text{Time}}{\text{D \& T}} + \underset{\text{Time}}{\text{Rtn}} + \underset{\text{Time}}{\text{S \& W}}$$

Factors effecting cycle time
1) Size & specification of loaders
2) Type & Condition of matrials loaded
3) Capacities of shovels & dumperes
4) skill level of operators
5) Efficiency
6) Hauling distance
7) Haulroad condition
8) Grades & other Conditions Governing hauling speed.
9) Man oeuvrability of vehicles.
10) Job efficiency.

Transportation Equipment

Transit mixer plant : Equipment used for transportation of Concrete from mixer to placing site depends on the distance involved & the volume of Concrete to be placed. Wheel barrows, with limited capacity say 0.04 m^3 and small motorized dumpers with capacity up to 1.0 m^3 are used for transporting & placing small quantities of Concrete.

"Concrete Transit mixers" are employed for transporting large quantities of Concrete over long distance

The no of truck mixers required for transporting Concrete can be worked out by evaluating the cycle time.

Ex^{n} Consider a typical mixer cycle-time data of 6 m^3 truck mixer with.

loading time for 6m^3 truck mixer = 14 min
travel time of loaded truck mixer = 7.5 min
Avg. waiting time at site = 7.5 min
Discharge time at site using Concrete pump = 15 min
Travel time for return trip = 5 min
Total Cycle time = 49 min.

$$\therefore \text{Truck mixer req} = \frac{\text{Cycle time}}{\text{Discharge time}} + 1 \text{ spare.}$$

$$= \frac{49}{15} + 1$$

$$= 5 \text{ No's.}$$

Selection of Construction Equipment

Proper selection of Equipment for a Construction project is of vital Importance for its speedy and Eco-nomical Completion.

1) **Suitability for Job Conditions** : The Equipment should be meet. the Requirement of the work, Climate and working conditions

2) **size of Equipment** : size of Equipment should be such that it must be able to be used with other matching units. Larger or Smaller selected Equipments will Remain idle which shall be uneconomical.

3) **Standardisation** : It is better to have same tippe of Equipment & same size of Equipments in the project. It should be easy for the operators to understand it, machanics will be able to maintain & Repair better as they become Expert by handling similar type of Equipment.

4) **Availability of Equipment** : The Equipment should be easily available and also Ensured that the Equipment is of repute & is likely to be Continued to be manufactured in future. also. This is necessary for future standerdisation and Ensuring Spare parts supply.

5) **Availability of Spare parts** : Downtime of the Eqpt for want of spare parts may not be more. And the availability of S.P will be available at reasonable price throughout the working life of Eqpt.

6) Multipurpose Equipments / versatility.

Eqpt. ~~Can be~~ selected Should perform more than one function and can be utilized fully.
eg: Excavator with wheel loader bucket arrangement has an one more fu" of rock breaker attachment.

7) Availability of know-how : Eqpt should be satisifactorily handeled by available Operators & mechanics.

8) use in future project : It should be kept in view that the Equipment can be used in future project and may not become Obsolete.

9) The Economical Aspects. : Cost of unit production should me minimum.

10) Reliability : Equipt. selected for project must be reliable

11) Service Support : Service support should be available in the area of proj ect where Equipment shall be used.

12) Operating Requirements : Equipment Selected Should be easy to operate & maintain, acceptable to the operator & should have lesser fuel Consumption

13) past performance : It is desirable to Enquire about its performance from other users

14) Reputation of Manufacturer

15) Warranty or Guarantee offered by Manufacturer

16) use of std Components in the Eqpt.

17) Adequacy of drive mechanism or power of mover.

Estimation of ownership cost, operational and maintenace cost of Construction Equipment

In Construction firms, it is Important to accurately estimate the Equipment cost as part of the total cost of the Construction project. Inaccurate Estimation of Constructior Equipment cost may adversely affect the profit margin of the firms especially Engaged in projects with more Involved of different types of Construction Equipments. The Total cost of a piece of Construction Equipment Consists of two Components namely

a) Ownership cost
b) Operating Cost.

This is also refferred as a O & O Cost of the Const^{n} Equipment. The Sel^{n} of a piece of Equipment in a Const^{n} project depends on the total Costs associated with that Equipment.

1) Ownership Cost: Is the Total Cost associated with the Construction Eqpt. for owning it irrespective of the Equipment is Employed.

It consists of the following

↳ Initial Cost / Investment cost ✓
↳ Salvage value
↳ Intrest Cost of Capital Investment
↳ Taxes
↳ Insurances cost
↳ Storage Cost.
↳ Depreciation. ✓
↳ Major repair Cost ✓

These are fixed or continous cost which arises repeatedly depends on the use of Eqpt.

Initial cost : Initial Cost is the Capital Investment required to ocon the Equipments. It includes purchase cost, Sales tax, taurpotation cost to bring the Equip. to the company storage yard. It also Includes Eqpt. Installation.

Salvage value : It Represents Expected cash-in-flow that will be Recived by desposing of Eqpt. @ the End of its useful life.

Intrest cost : It is the annual Cost of Interest charged on the borrowed Money or Capital Investment to acquire the Ownership of the Equipment.

Taxes: Reprents the property taxes to be paid to the State or Central governament. It depends on the value of the Equipment owned and the applicable tax rate for the given location.

Insurance Cost : It refrents the annual premium to be paid to Insurance Companies to Cover the Cost Incurred due to accident, fire, theft etc.

storage Cost : It is the Cost of keeping the Equipment in storage yards when it is not operating at the work site. It Includes rental and maintenance charge for storage yards, wages of Security gaurds & wages of workers Employed for bringing in & out of the storage yards

Depriciation Cost : It is due to the use & obsolence of Every Eqpt.

After this the Eqpt looses its value.

2) Operating cost

Operating cost is Incurred only when the Eqpt is operated. The operating cost of the Equipment is Influenced by various parameters namely number of operating hours, location of Jobsite, operating conditions, Category of Equipment etc. It Consists of

- ↳ Repair & Maintence cost
- ↳ fuel Cost
- ↳ Cost of lubricating oil, filter & grease
- ↳ Tire Cost
- ↳ Equipment operator wages.
- → Cost of replacing high-wear items
- ↳ Cost of mobilization, demobilization & assembly.

Cost of fuel

Consumption of fuel = 0.27 × load factor.

↳ varies from 30 to 10%.

Note

Actual Consumption of fuel of the Electricity depends on the Engine power, load factor & Engine Conditions

cost of lubricants

It Includes Engine oil, transmission oil, hydraulic oil, grease etc. These oils are Changed after every 100 to 200 hrs of working.

Service & Maintenance cost

Regular Service & Maintenance of each Eqpt is very Essential for perfect Condition of working.

Labour Cost

Labour Cost Includes salary of operators & helpers Engaged.

Repair Cost

This Cost Includes repairing & replacing the minor parts on the site or workshop.

other cost

Cost of watchman, light, water charges, uniforms

Determination of owning & operating cost

① owning charges = Defriciation per hour + $\frac{\text{Annual Expenditure}}{\text{hours used Annualy.}}$

② operating cost = a + b + c + d + e + f

a) hourly fuel cost = fuel Consumed hourly x Rate per ltr

b) Lubricating oil & other oil Cost used x Rate per ltr.

c) Tyre cost = $\frac{\text{Price of one set}}{\text{life of tyre.}}$

d) Repaire Charges per hour.

e) Wages of operators & helpers hourly

f) cost of any special item if required.

Owning & Operating Cost = ① + ②.

Depreciation

Depreciation is the reduction in the value of an asset due to usage, passage of time, wear and tear, technological outdating or obsolescence etc.

Depreciation is the loss in market value of the plant over a period of time resulting from usage, wear and tear of age.

Methods of Depreciation

Depending upon the Company policy, market trends and nature of usage, appropriate method of depreciation can be adopted.

1) Stright line method.
2) Declining Balance Method.
3) Sinking fund method.
4) Sum of digit method.
5) Units of production depreciation.
6) Annuity method.

Terms used : ① Residual Value : Residual value is an another name for Salvage value, the remaining value of an asset after it has been fully depreciated.

② Book value : Book value of an asset is the value at which the asset is carried on a balance sheet and calculated by taking the cost of an asset minus the accumulated depreciation.

B.V = cost - Acc. depreciation.

Stright line Method.

In this Method, an Equal amount is provided each years for depreciation of each asset untill the asset has been written down to nil or its scrap value at the End of estimated life of asset. The name of this method is derived from the fact if the successive annual depreciation over the life of the asset are ploted on a Graph, the result will be a stright line with a slope Equal to the annual depreciation. This method is also called 'Fixed Installment Method' because of uniform amount of depreciation is charge every year

Stright line depericiation Equation $\Longrightarrow D = \frac{C - S}{n}$

Where D = Annual Depreciation

C = Cost of asset

S = Salvage / Residual / scrap valee

n = Estimated life of years.

This method is Expected only when

→ An uniform Service through out its estimated useful life

→ Annual repairs & maintence cost are assumed to remain Constant over its life.

→ The asset is Expected to earn an equal amount of revenue each years throughout its life.

→ The amount of depreciation is a function of time only. & S. value is Relethively small.

① What is the Straight-line depreciation Expense for a truck that was purchased for $ 30,000 with a lifetime of 4 years & has a residual value of $ 2,000? Prepare 4 year depreciation schedule for the truck.

$C = 30,000$
$S = 2000$
$n = 4$ years

$$\Longrightarrow D = \frac{C - S}{n}$$

$$= \frac{30000 - 2000}{4}$$

$= \$\ 7000$ per year.

years	Depr-Expense.
1	$ 7000
2	$ 7000
3	$ 7000
4	$ 7000.
Total	$ 28,000. →

four year Depreciation schedule.

② A Crawler tractor purchase price is $ 1,00,000 & the assessed resale value after using for 5 years is 25% of the delivery price. This Equipment is planed to operate 2000 hrs per year.

$\Longrightarrow$ Delivery price = 1,00,000
Residual value = 25% of D.P = 25,000

$$D = \frac{C - S}{n} = \frac{1,00,000 - 25,000}{5} = \$\ 15,000.$$

Depreciation Cost for 5 years schedule = $5 \times 15,000$
$= \$\ 75,000.$

② End

② Sum-of-years-Digits (SYD) Depreciation

It is a method of accelerated depreciation that allocates larger amount of depreciation as an Expense during the earlier years of life of an asset ⓐ The method uses a reducing fraction Less: It is x'ly by (cost - residual)

↓

Book value.

i,e SYD fraction = Particular year (decreased by 1 each subsequent year) / Constant denominator.

↓

It is sum of the years till end.

$\frac{n(n+1)}{2}$ or Sum of Total year

ⓑ SYD Depreciation = SYD fraction × (cost - Residual)

SYD - Dep. Expense = SYD fraction × [cost - Residual]

Eg:ⁿ

Ⓟ What is the SYD four-year depreciation schedule for a truck that was purchased for $ 30,000 with a life time of 4 years and has a residual value of $ 2,000 ?

⟹ Const. denominator = $\frac{n(n+1)}{2}$ - $\frac{4(4+1)}{2}$ = 10

or 4 + 3 + 2 + 1 = 10.

Cost - Residual = 30,000 - 2000 = 28,000

Year	SYD fraction	×	Cost - Residual	=	Depreciation
1	4/10	×	28,000	=	11,200
2	3/10	×	28,000	=	8,400
3	2/10	×	28,000	=	5,600
4	1/10	×	28,000	=	2800
					28,000

Ques

(2) Same qsn of SL solve by SYD method.

⇒ Const. denominator = $\frac{n(n+1)}{2} = \frac{5(5+1)}{2} = \frac{30}{2} = (15)$

Or $5+4+3+2+1 = (15)$

Years	SYD fraction	×	Cost - Residual	=	Depreciation
1	5/15		75,000	=	25,000
2	4/15		75,000	=	20,000
3	3/15		75,000	=	15,000
4	2/15		75,000	=	10,000
5	1/15		75,000	=	5,000
				Total Dep =	75,000.

② Declining Balance Method.

Double

This provides means of accelerating depr. for tax purposes.

This is an another method of accelerated depreciation that allows greater amounts of depreciation to be expensed in the early years of the life of a depreciable asset. This method uses DDB percentage × book value

↓

Cost - accumulated depn.

@ Eqn to Calculate DDB %.

$$DDB\,\% = \frac{100\,\%}{\text{Life time}} \times 2 \rightarrow \text{new eqn.}$$

$$= \frac{100\,\%}{\text{Life time}} \times 1.5 \rightarrow \text{old eqn.}$$

(b) Depreciation expence = DDB % × Book value
(Cost − acc. dep.)

(c) The final book value must be greater than or Equal to residual value. In case the final book value for the last period is less than the residual value, the depreciation expense value of the last period will need to be changed to Ensure that the final book value is Equal to residual value.

What is DDB for four years depreciation schedule for truck that was purchased for $ 20,000 with a lifetime of 4 years & has a residual value of $ 2000 ?

$$\Longrightarrow \text{DDB \%} = \frac{100}{4} \times 2 = 50\ \%$$

Year	DDB %	× Book value	= Dep Exp.	Net Book value
0				$ 20,000
1	50 %	30,000	= $ 15,000	15,000
2	50 %	15,000	= 7,500	7 500
3.	50 %	7 500	= 3,750	3,750
4	50 %	3,750	= ~~+ 875~~ Adjust 1750	~~+ 875.~~ 2,000

↓ final Book Value

Book value > Resd value

2000 → 1875

(+) 125

Add

$ 2000.

Total accumulated Depr. = 15,000 + 7,500 + 3,750 + 1275

= $ 28,125 → − 125.

But

= $ 28,000

final book value = Cost − Acc Dep.

= 30000 − 28,000

= $ 2 000

④ Units-of-production Depreciation.

A method of depreciation basing expense on number of units used or produced by the asset during an accounting period to the total Estimated units to be used or produced during the life of the asset.

ⓐ Depr. Rate per unit = $\frac{\text{Cost} - \text{Residual}}{\text{Life in units}}$

ⓑ Depr. Expense = Depr. Rate per unit × Units used.

Eg: A truck purchased for $ 30000 with a residual value of $ 2,000 and a life of 100000 miles. During the period of June-Sept, the truck record is 5,200 miles of uses. what is the units of production depr. for truck during the period.

⟹ ⓐ D. Rate per unit = $\frac{30000 - 2000}{100000}$

= $ 0.28/mile

ⓑ Dep Expense = 0.28 × 5200 = $ 1,456

⑤ Sinking fund method.

Under this method, depreciation is a provision by charging out of revenue for replacement of an asset & a means of maintaining capital.

$$d = \frac{C\,i}{(1+i)^n - 1}$$

where d = sinking fund depr.
C = cost of the asset
S = Salvage value
i = Rate of Interest
n = years.

⑥ Annuity method

$$A = \frac{C\,i(1+i)^n}{(1+i)^n - 1}$$

where A = Annuity depreciation
C = cost of the asset
S = Salvage value
i = Rate of Interest in decimal term
n = Estimated life of asset.

Replacement Analysis

Replacement analysis is carried out when there is a need to replace or augment the currently owned equipment (or any asset). There are various reasons that result in replacement of a given equipment. One of the reasons is the reduction in the productivity of currently owned equipment. This occurs due to physical deterioration of its different parts and there is decrease in operating efficiency with age. In addition to reduced productivity, there is also increase in operating and maintenance cost for the construction equipment due to physical deterioration. This necessitates the replacement of the existing one with the new alternative. Similarly if the production demands a change in the desired output from the equipment, then there is requirement of augmenting the existing equipment for meeting the required demand or replacing the equipment with the new one. Another reason for replacement of the existing equipment is obsolescence. Due to rapid change in the technology, the new model with latest technology is more productive than the currently owned equipment, although the currently owned equipment is still operational and functions acceptably. Thus continuing with the existing equipment may increase the production cost. The impact of rapid change in technology on productivity is more for the equipment with more automated facility than the equipment with lesser automation.

In replacement analysis, the existing (i.e. currently owned) asset is referred as **defender** whereas the new alternatives are referred as **challengers**. In this analysis the 'outsider perspective' is taken to establish the first cost of the defender. This initial cost of the defender in replacement analysis is nothing but the estimated market value from perspective of a neutral party. In other words this cost is the investment amount which is assigned to the currently owned asset (i.e. defender) in the replacement analysis. The current market value represents the opportunity cost of keeping the defender i.e. if the defender is selected to continue in the service. In other words, if the defender is selected, the opportunity to obtain its current market value is forgone. Sometimes the additional cost required to upgrade the defender to make it competitive for comparison with the new alternatives is added to its market value to establish the total investment for the defender. Along with the market value, there will be revised estimates for annual operating and maintenance cost, salvage value and remaining service life of the defender, which are expected to be different from the original values those were estimated at the time of acquiring the asset. The past estimates of initial cost, annual operating and maintenance cost, salvage value and useful life of defender are not relevant in the replacement analysis and are thus neglected. The past estimates also incorporate a **sunk cost** which is considered irrelevant in replacement analysis. Sunk cost occurs when the book value (as determined using depreciation method) of an asset is greater than its current market value, when the asset (i.e. defender) is considered for replacement. In other words it represents the amount of past capital investment which cannot be recovered for the existing asset under consideration for replacement. Sunk cost may occur due to incorrect estimates of different cost components and factors related productivity of the defender, those were made at the time of original estimates in the past with uncertain future conditions. Since sunk cost represents a loss in capital investment of the asset, the income tax calculations can be done accordingly by considering this capital loss. In replacement analysis the incorrect past estimates and decisions should not be considered and only the cash flows (both present and future) applicable to replacement analysis should be included in the economic analysis. For replacement analysis, it is important know about different lives of an asset, as this will assist in making the appropriate replacement decision. The different lives are physical life, economic life and useful life. **Physical life** of an asset is defined

as the time period that is elapsed between initial purchase (i.e. original acquisition) and final disposal or abandonment of the asset. **Economic life** is defined as the time period that minimizes the total cost (i.e. ownership cost plus operating cost) of an asset. It is the time period that results in minimum equivalent uniform annual worth of the total cost of the asset. **Useful life** is defined as the time period during which the asset is productively used to generate profit. In replacement analysis the defender and challenger is compared over a study period. Generally the remaining life of the defender is less than or equal to the estimated life of the challenger. When the estimated lives of the defender and challenger are not equal, the duration of the study period has to be appropriately selected for the replacement analysis. When the estimated lives of defender and challenger are equal, annual worth method or present worth method may be used for comparison between defender and the challengers (new alternatives).

In the following example, replacement analysis involving equal lives of defender and challenger is discussed.

A construction company has purchased a piece of construction equipment 3 years ago at a cost of Rs.4000000. The estimated life and salvage value at the time of purchase were 12 years and Rs.850000 respectively. The annual operating and maintenance cost was Rs.150000. The construction company is now considering replacement of the existing equipment with a new model available in the market. Due to depreciation, the current book value of the existing equipment is Rs.3055000. The current market value of the existing equipment is Rs.2950000. The revised estimate of salvage value and remaining life are Rs.650000 and 8 years respectively. The annual operating and maintenance cost is same as earlier i.e. Rs.150000.

The initial cost of the new model is Rs.3500000. The estimated life, salvage value and annual operating and maintenance cost are 8 years, Rs.900000 and Rs.125000 respectively. Company's MARR is 10% per year. Find out whether the construction company should retain the ownership of the existing equipment or replace it with the new model, if study period is taken as 8 years (considering equal life of both defender and challenger).

Solution:

For the replacement analysis, initial cost (Rs.4000000), initial estimate of salvage value (Rs.850000) and remaining life (12 – 3 = 9 years) and current book value (Rs.3055000) of the existing equipment (i.e. defender) are irrelevant. Similarly sunk cost of Rs.105000 (Rs.3055000 – Rs.2950000) is also not relevant for the replacement analysis. For the replacement analysis the current revised estimates of the existing equipment will be used.

For existing equipment (defender),

Current market value (P) = Rs.2950000, Salvage value (F) = Rs.650000,

Annual operating and maintenance cost (A) = Rs.150000, Study period (n) = 8 years.

For new model (challenger),

Initial cost (P) = Rs.3500000, Salvage value (F) = Rs.900000,

Annual operating and maintenance cost (A) = Rs.125000, Study period (n) = 8 years.

Now the equivalent uniform annual worth of both defender (i.e. the existing equipment) and challenger (i.e. the new model) at MARR of 10% (i.e. i = 10%) are calculated as follows;

For defender;

$$AW_{def} = -2950000(A/P,i,n) - 150000 + 650000(A/F,i,n)$$

$$AW_{def} = -2950000(A/P,10\%,8) - 150000 + 650000(A/F,10\%,8)$$

$$AW_{def} = -2950000 \times 0.1874 - 150000 + 650000 \times 0.0874$$

$$AW_{def} = -646020$$

For challenger;

$$AW_{cha} = -3500000(A/P,i,n) - 125000 + 900000(A/F,i,n)$$

$$AW_{cha} = -3500000(A/P,10\%,8) - 125000 + 900000(A/F,10\%,8)$$

$$AW_{cha} = -3500000 \times 0.1874 - 125000 + 900000 \times 0.0874$$

$$AW_{cha} = -702240$$

From the above calculations, it is observed that equivalent uniform annual cost of the defender is less than that of the challenger. Thus the construction company should continue in retaining the ownership of the defender against the challenger with above details. Since the useful lives of defender and challenger are equal, the same conclusion will also be obtained by using present worth method for economic evaluation.

Initial cost (P) = Rs.3500000, Salvage value (F) = Rs.900000,

Annual operating and maintenance cost (A) = Rs.125000, Study period (n) = 8 years.

Now the equivalent uniform annual worth of both defender (i.e. the existing equipment) a challenger (i.e. the new model) at MARR of 10% (i.e. i = 10%) are calculated as follows;

For defender;

$$AW_{def} = -2950000(A/P,i,n) - 150000 + 650000(A/F,i,n)$$

$$AW_{def} = -2950000(A/P,10\%,8) - 150000 + 650000(A/F,10\%,8)$$

$$AW_{def} = -2950000 \times 0.1874 - 150000 + 650000 \times 0.0874$$

$$AW_{def} = -646020$$

For challenger;

$$AW_{cha} = -3500000(A/P,i,n) - 125000 + 900000(A/F,i,n)$$

$$AW_{cha} = -3500000(A/P,10\%,8) - 125000 + 900000(A/F,10\%,8)$$

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Equipment Maintenance.

Retaining or Restoring a piece of Equipment, machine or System to the specified operable Condition to achive its maximum useful life. Regular maintenance is Essential to keep premises, Equipment, machines and the work Enviroment Safe and reliable.

Every Machine is thoroughly tested and Inspected by the manufacturers before Selling. After usage it is subjected to wear and tear, hence proper attention should be given to protect the machine and its components from undue wear & thus protect them from failures. Proper Attention means Lubrication, cleaning, timely Inspection and Systematic maintence. Maintenance means efforts directed towards the up keep & the repair of that machine. Repair must be done at the time when it may have least disruptions ie machine may be repaired when it is not being used or its use may be postponed without affecting the production much. Thus, maintenance is responsible for the Smooth & Effective working of an Industry & helps in Improving the productivity it also helps in keeping the machine in a State of maximum Efficiency and Economy.

following are the types of maintenances.

↳ Repair maintenance can be followed for non-critical Equipments and where failures are unpredicted

↳ Corrective maintence should be adopted for frequently failing Components

↳ preventive maintenance
(planned / scheduled or Systematic maintenance)

periodic Inspection or Checking at the predecided frequency helps to findout the reson leading to breakdown and to rectify them when they are in minor / initial stages. Then Enable to Carry out the Repair when one wants to do it i,e when it has least Effect on the product Schedule. Further this repairs Requires lesser time as Compaired to that of breakdown repairs & thus down time is reduced by doing preventive maintence.

Eg: A typical Example of an asset with a time based preventive maintence is an Air-Conditioner which is Serviced every year bfor Summer

Functions of preventive Maintenance

1) Inspection or Checkups at Carefully decided frequencies.
2) Lubrication, Mechanical components like gears, bearings, bushes and other fricion surfaces give good performence for long periods when they are systematically lubricated. Application of right type of lubricant at the right time, at the right place & in right quantity.
3) Every preventive maintenance work should be pre-planned.
4) Good record keeping is Essential.
5) Training of maintenance personnel.
6) Storage of maintenance spares.

Advantages of preventive Maintenance

1) Less overtime work required as it is pre-planned
2) Less repair costs
3) Less production downtime
4) Less stand-by Equipments needed
5) Increased life Expectancy.
6) Better spare parts Control leading to reduced Inventory
7) More reliability.

Corrective maintenance : It is a maintanence task performed to Identify, Isolate & rectify a fault so that the failed Equipment, machine or system can be restored to an operational Condition within the tolerances or limits Established for in-service oprs.

Corrective maintanence can be subdivided in to

↳ Immediate C.M – Work starts Immediately after a failure
↳ Deferred C.M – Work is delayed in Conformance to a given set of maintenance rules

Ex: 1) Emergency repair : urjent repairs such as broken elevator filled with people

2) Service outges : Restroing service that are down

3) Repair : Repairing things that are broken such as Machinery parts

4) Performence & Quality of machineries & plants

Advantages 1) Emergency maintenance requirments are reduced.

2) Heavy down time losses are measured
3) plant availability is Increased
4) Results in better utilis" of plant facilities
5) Safty level is Improved & hence there are less chances of accidents
6) provides Sufficient Information regarding maintence replacement & repair.

Materials

Materials Management is a function which aims for Integrated approach towards the management of materials. Its main object is Cost reduction and Efficient handling of materials. The scope of Material management varies greatly from Company to Company and may Include materials planning and Control, production planning, purchasing, Inventory Control & Stores, in-plant materials movement & waste management.

Objective of Material Management

1) To reduce Material Cost
   a) Efficient Control of Inventories which helps in releasing the working capital for productive purpose.
2) To Ensure uniform flow of material for production
4) To Ensure right quality at right price.
5) To made Improved items & to find their substitutes. 6) To make high Inventory turnover.

The main purpose of Material management is to assure that the right materials are in the right place, in the right quantity when needed. The Responsibility of material mgt dept for the flow of materials from the time the materials ordered, received & stored untill they are used in the basis of material Management

Inspection

All Incoming materials on receipt is physically checked, counted and then referred to Inspection/ Quality Control department to Ensure whether it meets the purchase order requirements. The rejected items are returned to the supplier, while accepted items are Identified, sent to Storage for recording & keeping them properly at their respective locations Sometimes Inspection of items are Carried out at Suppliers place known as pre-delivery Inspection.

Def: Inspection is the process of sorting bed items and then rejecting them.

Inspection (or) is the ~~process of~~ ~~Sorting~~ ~~bed~~ Art of Comparing materials Products or performances with Established Standards.

5) Inventory Control function

Effective Inventory control is a must for effective & efficient running of the production cycle with least Interruptions. Inventories refer to those items which are either Stocked for sale or they are in the process of manufacturing or they are in the form of materials which are yet to be utilised.

3) Store keeping / store Management functions

Store-keeping is the Safe Custody of items of materials stocked in the store-room for which the store-keeper acts as a trustee. Store keeping can be defined as the physical storage of Materials carried into the Store room in a Scientific and Systematic manner with a view to
↳ Save them from the damages & losses
↳ Exercise overall Control over their Movement.

It Includes physical Control on materials such as Conservation of materials on stores, timely disposal & Efficient handling, maintaining stores records, proper location & Stocking.

4) Quality Control and Inspection.

Quality Control is the Control of Quality of the materials. The Quality of a product Comprises several Engineering and manufacturing Characteristics to meet the performance Expectations of the designer and the Customers. Quality of any product is regarded as the degree to which it fulfills the requirements of the Customer. It Includes appearance, performance, life, dependability, reliability, durability, maintainability, Smell, tasteful sound etc.

Inventory Management

It is necessary for every management to give proper attention to inventory management. A proper planning of purchasing, handling storing and accounting should form a part of inventory management. An efficient system of inventory management will determine (a) what to purchase (b) how much to purchase (c) from where to purchase (d) where to store, etc.

There are conflicting interests of different departmental heads over the issue of inventory. The finance manager will try to invest less in inventory because for him it is an idle investment, whereas production manager will emphasise to acquire more and more inventory as he does not want any interruption in production due to shortage of inventory. The purpose of inventory management is to keep the stocks in such a way that neither there is over-stocking nor under-stocking. The over-stocking will mean reduction of liquidity and starving of other production processes; under-stocking, on the other hand, will result in stoppage of work. The investments in inventory should be kept in reasonable limits.

Objects of Inventory Management

The main objectives of inventory management are operational and financial. The operational objectives mean that the materials and spares should be available in sufficient quantity so that work is not disrupted for want of inventory. The financial objective means that investments in inventories should not remain idle and minimum working capital should be locked in it. The following are the objectives of inventory management:

(1) To ensure continuous supply of materials spares and finished goods so that production should not suffer at any time and the customers demand should also be met.

(2) To avoid both over-stocking and under-stocking of inventory.

(3) To keep material cost under control so that they contribute in reducing cost of production and overall costs.

(4) To minimise losses through deterioration, pilferage, wastages and damages.

(5) To ensure perpetual inventory control so that materials shown in stock ledgers should be actually lying in the stores.

(6) To ensure right quality goods at reasonable prices.

(7) To maintain investments in inventories at the optimum level as required by the operational and sales activities.

(8) To eliminate duplication in ordering or replenishing stocks. This is possible with help of centralising purchases.

(9) To facilitate furnishing of data for short term and long term planning and control of inventory.

(10) To design proper organisation of inventory. A clear cut accountability should be fixed at various levels of management.

Tools and Techniques of inventory Management

Effective Inventory management requires an effective control system for inventories. A proper inventory control not only helps in solving the acute problem of liquidity but also increases profits and causes substantial reduction in the working capital of the concern. The following are the important tools and techniques of inventory management and control:

Determination of Stock Levels.

Determination of Safety Stocks.

Determination of Economic Order Quantity

A.B.C. Analysis

VED Analysis

Inventory Turnover Ratios

Aging Schedule of Inventories

Just in Time Inventory

1. Determination of Stock Levels

Carrying of too much and too little of inventories is detrimental to the firm. If the inventory level is too little, the firm will face frequent stock-outs involving heavy ordering cost and if the inventory level is too high it will be unnecessary tie-up of capital. Therefore, an efficient inventory management requires that a firm should maintain an optimum level of inventory where inventory costs are the minimum and at the same time there is not stock-out which may result in loss of sale or stoppage of production. Various stock levels are discussed as such.

(a) Minimum Level: This represents the quantity which must be maintained in hand at all times. If stocks are less than the minimum level then the work will stop due to shortage of materials. Following factors are taken into account while fixing minimum stock level:

Lead Time: A purchasing firm requires some time to process the order and time is also required by supplying firm to execute the order. The time taken in processing the order and then executing it is known as lead time.

Rate of Consumption: It is the average consumption of materials in the factory. The rate of consumption will be decided on the basis pas experiences and production plans.

Nature of Material: The nature of material also affects the minimum level. If material is required only against special orders of customer then minimum stock will not be required for such materials.

Minimum stock level = Re-ordering level-(Normal consumption x Normal Re-order period).

(b) Re-ordering Level: When the quantity of materials reaches at a certain figure then fresh order is sent to get materials again. The order is sent before the materials reach minimum stock level. Reordering level is fixed between minimum and maximum level.

The rate of consumption, number of days required to replenish the stock and maximum quantity of material required on any day are taken into account while fixing reordering level.

Re-ordering Level = Maximum Consumption x Maximum Re-order period.

(c) Maximum Level: It is the quantity of materials beyond which a firm should not exceed its stocks. If the quantity exceeds maximum level limit then it will be overstocking. A firm should avoid overstocking because it will result in high material costs.

Maximum Stock Level = Re-ordering Level+ Re-ordering Quantity - (MinimumConsumption x Minimum Re-ordering period).

(d) Danger Level: It is the level beyond which materials should not fall in any case. If danger level arises then immediate steps should be taken to replenish the stock even if more cost is incurred in arranging the materials. If materials are not arranged immediately there is possibility of stoppage of work.

Danger Level = Average Consumption x Maximum reorder period for emergency purchases.

(e) Average Stock Level:The average stock level is calculated as such:

Average Stock level = Minimum Stock Level +½ of re-order quantity

2. Determination of Safety Stocks

Safety stock is a buffer to meet some unanticipated increase in usage. It fluctuates over a period of time. The demand for materials may fluctuate and delivery of inventory may also be delayed and in such a situation the firm can face a problem of stock-out. The stock-out can prove costly by affecting the smooth working of the concern. In order to protect against the stock out arising out of usage fluctuations, firms usually maintain some margin of safety or safety stocks. Two costs are involved in the determination of this stock i.e. opportunity cost of stock-outs and the carrying costs. The stock out of raw materials cause production disruption resulting in higher cost of production. Similarly, the stock out of finished goods result into failure of firm in competition, as firm cannot provide proper customer service. If a firm maintains low level of safety frequent stock out will occur resulting in large opportunity coast. On the other hand larger quantity of safety stock involves higher carrying costs.

3. Economic Order Quantity (EOQ)

A decision about how much to order has great significance in inventory management. The quantity to be purchased should neither be small nor big because costs of buying and carrying materials are very high. Economic order quantity is the size of the lot to be purchased which is economically viable. This is the quantity of materials which can be purchased at minimum costs. Generally, economic order quantity is the point at which inventory carrying costs are equal to order costs. In determining economic order quantity it is assumed that cost of a managing inventory is made of solely of two parts i.e. ordering costs and carrying costs.

(A) Ordering Costs: These are costs that are associated with the purchasing or ordering of

materials. These costs include:

(1) Inspection costs of incoming materials.

(2) Cost of stationery, typing, postage, telephone charges etc.

(3) Expenses incurred on transportation of goods purchased.

These costs are also know as buying costs and will arise only when some purchases are made.

(B) Carrying Costs: These are costs for holding the inventories. These costs will not be incurred if inventories are not carried. These costs include:

(1) The cost of capital invested in inventories. An interest will be paid on the amount of capital locked up in inventories.

(2) Cost of storage which could have been used for other purposes.

(3) Insurance Cost

(4) Cost of spoilage in handling of materials

Assumptions of EOQ: While calculating EOQ the following assumptions are made.

1. The supply of goods is satisfactory. The goods can be purchased whenever these are needed.

2. The quality to be purchased by the concern is certain.

3. The prices of goods are stable. It results to stabilise carrying costs.

Economic order quantity can be calculated with the help of the following formula

where, A = Annual consumption in rupees.

S = Cost of placing an order.

I = Inventory carrying costs of one unit.

4. A-B-C Analysis

Under A-B-C analysis, the materials are divided into three categories viz, A, B and C. Past experience has shown that almost 10 per cent of the items contribute to 70 percent of value of consumption and this category is called 'A' Category. About 20 per cent of the items contribute about 20 per cent of value of consumption and this is known as category 'B' materials. Category 'C' covers about 70 per cent of items of materials which contribute only 10 per cent of value of consumption. There may be some variation in different organisations and an adjustment can be made in these percentages.

A-B-C analysis helps to concentrate more efforts on category A since greatest monetary advantage will come by controlling these items. An attention should be paid in estimating requirements, purchasing, maintaining safety stocks and properly storing of 'A' category materials. These items are kept under a constant review so that substantial material cost

may be controlled. The control of 'C' items may be relaxed and these stocks may be purchased for the year. A little more attention should be given towards 'B' category items and their purchase should be undertaken a quarterly or half-yearly intervals.

5. VED Analysis

The VED analysis is used generally for spare parts. The requirements and urgency of spare parts is different from that of materials. A-B-C analysis may not be properly used for spare parts. Spare parts are classified as Vital (V), Essential (E) and Desirable (D) The vital spares are a must for running the concern smoothly and these must be stored adequately. The non-availability of vital spares will cause havoc in the concern. The E type of spares are also necessary but their stocks may be kept at low figures. The stocking of D type of spares may be avoided at times. If the lead time of these spares is less, then stocking of these spares can be avoided.

6. Inventory Turnover Ratios

Inventory turnover ratios are calculated to indicate whether inventories have been used efficiently or not. The purpose is to ensure the blocking of only required minimum funds in inventory. The Inventory Turnover Ratio also known as stock velocity is normally calculated as sales/average inventory or cost of goods sold/average inventory cost.

7. Aging Schedule of Inventories

Classification of inventories according to the period (age) of their holding also helps in identifying slow moving inventories thereby helping in effective control and management of inventories. The following table show aging of inventories of a firm.

9. Just in Time Inventory (JIT)

JIT is a modern approach to inventory management and goal is essentially to minimize such inventories and thereby maximizing the turnover. In JIT, affirm keeps only enough inventory on hand to meet immediate production needs. The JIT system reduces inventory carrying costs by requiring that the raw materials are procured just in time to be placed into production. Additionally, the work in process inventory is minimized by eliminating the inventory buffers between different production departments. If JIT is to be implemented successfully there must be high degree of coordination and cooperation between the suppliers and manufacturers and among different production centers.

Risk in Inventory Management

The main risk in inventory management is that market value of inventory may fall below what firm paid for it, thereby causing inventory losses. The sources of market value of risk depend on type of inventory. Purchased inventory of manufactured goods is subject to losses due to changes in technology. Such changes may sharply reduced final prices of goods when they are sold or may even make the goods unsaleable. There are also substantial risks in inventories of goods dependent on current styles. The ready-made industry is particularly susceptible to risk of changing consumer tastes. Agricultural commodities are a type of inventory subject to risks due to unpredictable changes in production and demand.

Mod: 3

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Construction Quality Safety and human Values.

Quality means Conformance to specifications, standards and Conformate to Requirements. Quality is fitness for use. Quality refers to productivity. The Quality of product is decided by Customer's needs. Conformance to specifications. The degree to which a set of Inherent Characteristics full fills Requirements. The Requirements are the needs & expectations that are stated, Generally Implied or obligatory [ISO: 9000-2000]. Quality is what the Customer says it is. Quality is Excellence in everything.

Dimensions of Quality are as follows

Performance: It is the main operating characteristics of a product
eg: Comfort in an automobile.

Features : Enhancement that is supplementing the product's basic function.
eg: Remote Control switch in Colour TV set

Reliability : Probability that a product will fail within a given period of time.

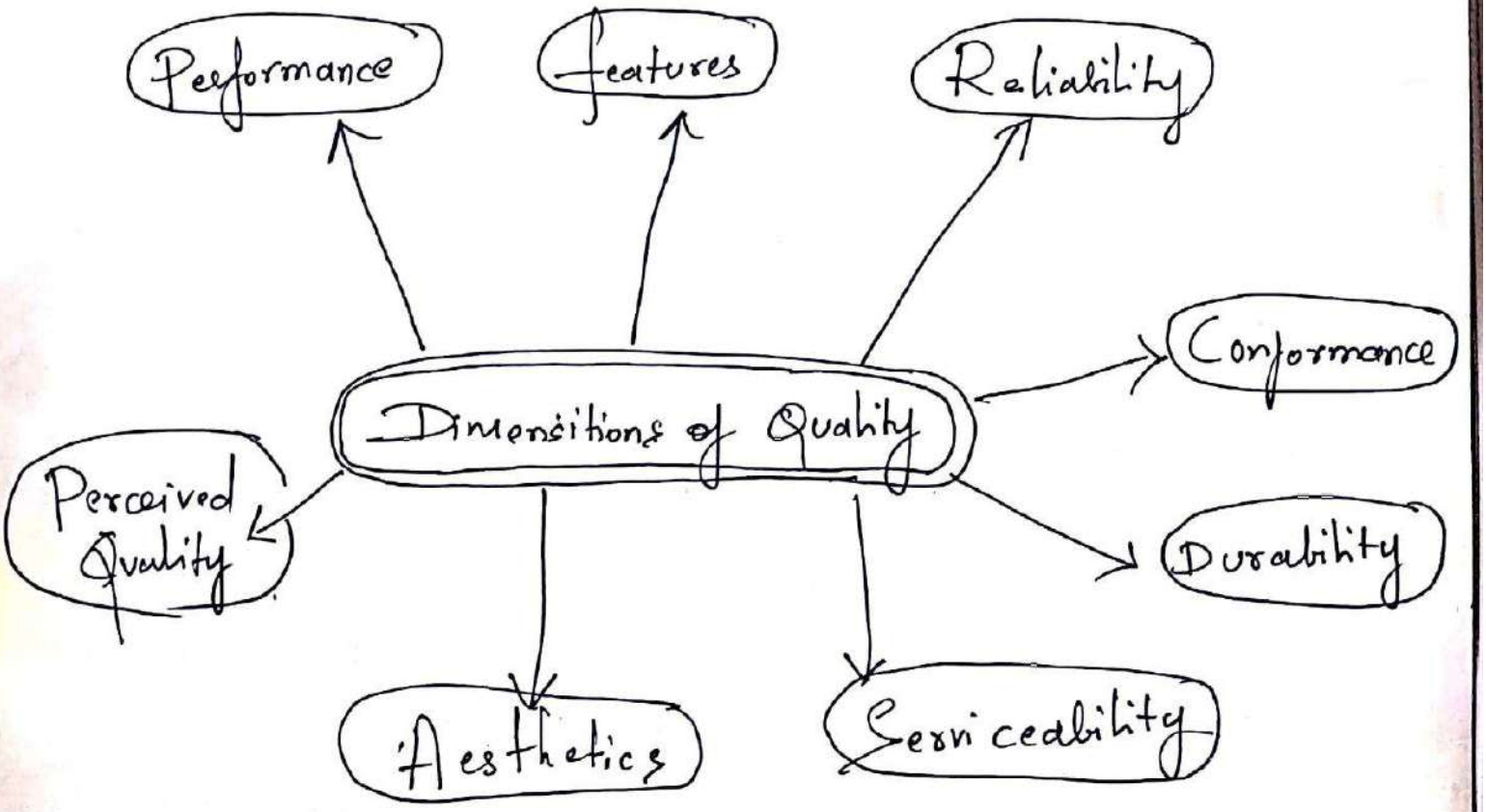
Conformance : The Extent to which the product's design & operating characteristics & also Satisfy the pre-determined standards.

Durability : Measure of product's useful life.

Serviceability : Time Consumed in Servicing, Courtesy, Competence & Ease of repair or reconditioning of a product.

Aesthetics : Human Response to a product (How it looks, feels, Sounds, tastes or Smells i.e appeals to Senses)

Perceived Quality : Impressions formed about the product's Quality from tangible & Intangible features of the product, brand image, good will & the Reputation of the organization.



Construction Quality process [Quality Control] QC

A/c to the Contractor's definition of how the project quality will be managed during Construction of the project. Iso 9000 defines Quality Control as "A part of Quality management focused on fulfilling Quality Requirements".

objectives of QC

1) It is to provide products which are dependable, satisifactory and Economical.
2) To Ensure Economic production of products of uniform quality acceptable to the Customer
3) Aims at preventing the defects rather that detecting the defects.
4) Reduces errors and Enhance Quality & productivi
5) Inspire more effective team work
6) Improve Communition in the Organisation.
7) Develop Greater Safety apareness & promote Cost reduction.

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QC

Once the defects or non-Conformances of product produced a process became Significant, the Inspection plan was spread out to cover the Complete process & applied at Various stages, Covering specific options to minimizing number of defects. This process of quality management is Called Quality Control.

Quality ~~Quan~~ Control is based on the defection Concept and is Reactive in nature. QC in addition to Inspection Involves the use of

→ Basic Statistical Methods
→ problem Solving Techniques.
→ Sophistication in Inspecting & Testing Methods.

other tools of Quality Management

- Control Chart
- Check sheet
- Histogram
- Scatter diagram
- flow Chart
- Fish bone diagram
- parallel Chart
- Stem & Leaf plot.

Needs of QC

- Increased productivity
- Reduced Cost of repairs.
- Increased Royal Customer base
- Better profits

Case studies on Qc Measures adopted in Cement Industry.

1) The Q.C in Cement Manufacturing plant starts from the Extensive testing of 'CaO' Content. & also make sure that the 'CaO' Content is uniform.

2) It is Ensured that the limestone is uniformly Crushed in Vertical Roll Mill.

3) The homogenised material is passed through series of Suspension pre-heater & is fed up into the kiln for production of clinkers. Hourly samples of clinkers are tested to assure uniformity of quality with the help of X-ray analyser.

4) The clinker is then proceeded through Closed circuit grinder to Ensure proper partical size distrubation

5) The Materials are then moved into high Efficiency cyclonic Separator which Separates the ground particles in to 2 streams (Fine & Coarser particles)

6) The Coarser particles are Collected and brought for Re-circulates in to grinding process.

7) The Consistency of particle size is checked using Sophesticated particle size analyser which Immediately indicate the grain size distribution. There by assuring the Consistent Quality.

8) Hourly Samples are Collected from packing house to check the Quality of Cement.

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9) Daily test for various Chemical and physical properties are done and Recorded to study the monthly Variations & to Improve the quality from time to time and there by minimize the Variations.

Quality Assurance (QA)

QA is the process of directing the organisation efforts towards the processes and Methods with an aim to prevent non-Conformances from occuring to achieve the Quality objectives.

QA Essentially Involves the following.

* Say what you do.
* Do what you Say
* Record what you do.

In order to achive the above Requirements in practice QA Involves development, Implementation and adherance to quality System which is framework of Quality management and Inturn guides the Organisation in its quality movement

QA has following features

* It puts into a place a quality System
* It predatermines the quality objectives to be achived and the Methods, processes to achive are laid down
* Quality cost Especially failure Cost are Significantly Reduced.

3rd party Signification in this Regard will help the firm or Company in many way such as

→ Builds up Image
→ provides tool for marketing
→ Increases Customers Confidence
→ Improves its own Efficiency
→ It Improves the Employees moral.

Cost of Quality

Cost of quality is an approch used to track the Effectiveness of the TQM process to select quality Improvement projects and to provide cost Justification.

It is a Methodology that allows an organization to determine the Extent to which its Resources are used for activities that prevent poor Quality, that apparise the Quality of organisation products or Services which Results from Internal and External failure.

"cost of Quality" is not the price of Creating a Quality product. It is the cost of NOT Creating a Quality product

Every time work is Redone, the cost of Quality Increase

→ Reworking of manufactured item
→ The Retesting of an assembly.
→ Re-building of a tool.

The breakdown of quality cost :

Quality costs = Control costs + Failure Costs

Control costs = prevention Cost + Appraisal Costs

Failure Costs = Internal failure cost + External failurecost

In terms of Construction, the prevention costs are the costs resulting from quality activities employed to avoid deviations.

Appraisal cost Consist of costs Incurred from quality activities employed to determine whether a product, process or service Conforms to established requirements.

Failure costs are the costs resulting from not meeting the requirements.

Internal failure costs are the costs Incurred on the project site due to scrap, rework, failure analysis re-Inspection, supplier error or price Reduction due to non-Conformance

External failure cost are the costs Incurred once the project ~~site due to ser~~ is in the hands of the Client. This Include costs for adjustments of Complaints, repairs, handling & Replacement of rejected material, workmanship, Correction of errors & litigation costs.

Total Quality Management. [TQM]

Total Quality Management is defined as a Continuous Effort by the management as well as Employees of a particular organization to Ensure long term Customer loyality & Customer satisfaction.

T - Total : Made up of Complete (or) Whole

Q - Quality : Degree of Excellence a product or a service provides to the Customer in present & future.

M - Management : Act, Art or manner of planning, handling Controlling.

TQM : is the Art of Managing the whole to achieve Excellence.

Essential features of TQM.

↳ It is Customer driven
↳ It can be straight away adopted without going through Quality assurance programme.
↳ It based on facts, data and analysis.
↳ It Strikes for Continuous Improvement
↳ It focuses people and hence calls for maximum Employees participation.
→ It calls for Cultural Change in the organization.

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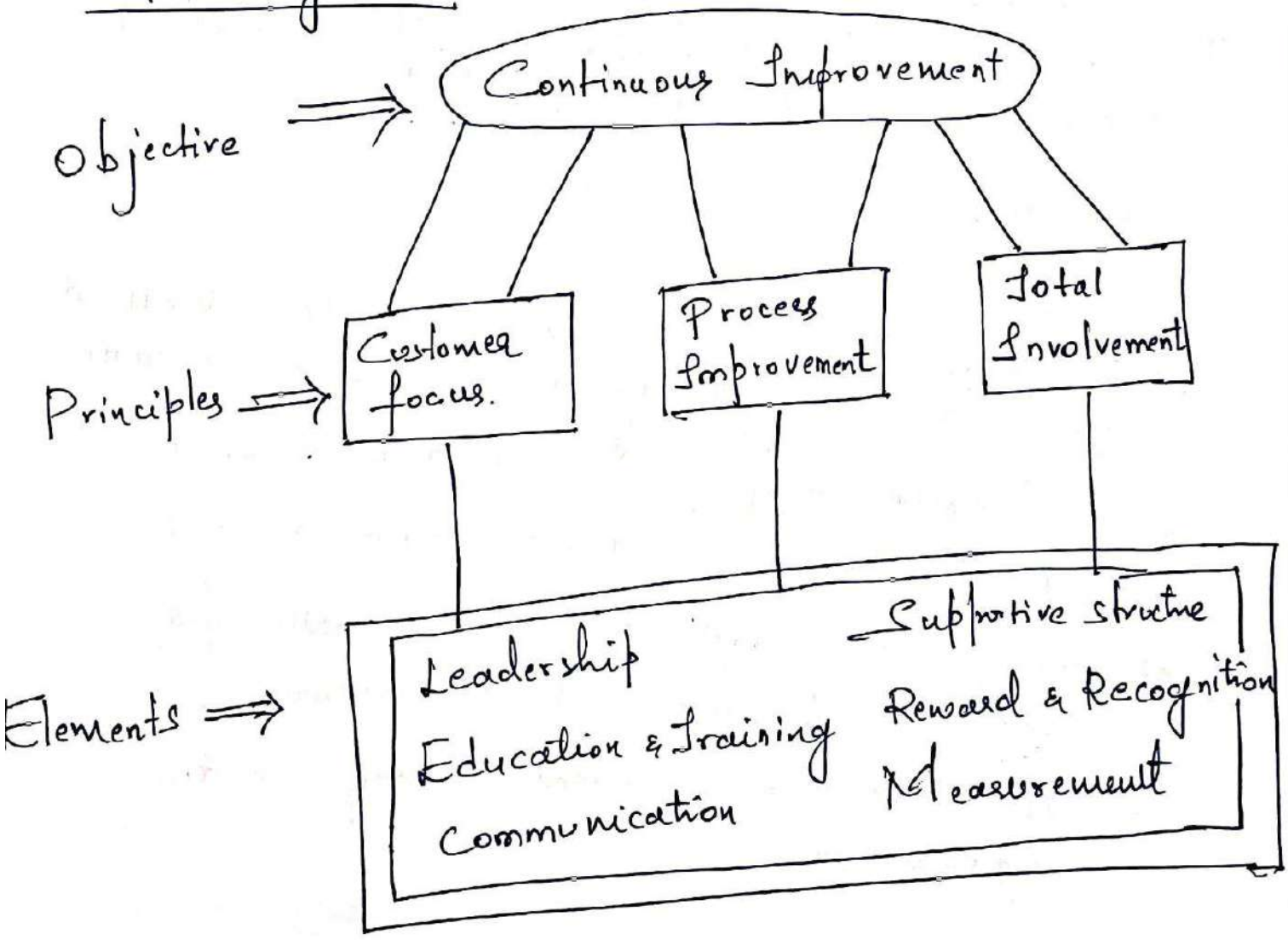
Cost of Quality

Evolution of TQM

Time.	Early 1900's	1940's	1960's	1980's & beyond
Focus	Inspection	Statistical Sampling	organizational Quality focus	Customer driver Quality
	⟸ old Concept of Quality: Inspect for Quality after production			⟹ New Concept of Quality: Built Quality Into the proces

TQM System.



Benifits of TQM. and Basic principles of TQM

The goal of TQM is
" To do the right thing for first time and every time".

Two Basic principles of TQM.

① Customers Satisfaction

Customer Satisfaction & Continuous Improvement are the fundamental goals of TQM and therefore the principles upon which it is based. All the efforts undertaken in TQM are directed towards a target of Satisfying the Customer through Continuously Improving upon the present methods and procedures that govern the work.

It Includes

a) Cust: satisfaction.
- ↳ Focus on customer
- ↳ Identify Internal Customers
- ↳ Establish a chain of Customers.

b) Satisfy the Supplier
- ↳ External Supplier
- ↳ Internal supplier
- ↳ Customer feedback
- ↳ Company philosophy
- ↳ participation & Team work.

② Continual Improvement

2 functions

↳ firstly to maintain and Incrementally Improve Current methods and procedures through process Control

↳ Second - To direct the Efforts i.e. necessary to achieve the major technological advances in Engineering the Construction processes through Innovation.

A/c to plan - Do - Check - Act [PDCA]

A problem Analysis process for narrowing the gap b/n Customer needs & present performance. It is a systematic procedure for Incrementally Improving methods and procedures by focusing on the Correction and prevention of defects. This is accomplished by removing the root cause of problems and Continuously Establishing & Revising standards.

PDCA

Plan

- Define the problem & Identify the target of Improvement
- Analyze the present Situation
- Identify root Causes & their effects
- Develop plan for Corrective action.

Do → Implement and Execute plan.

Check →
- Confirm results of Executed plan by Comparing them with the original planned target
- Standardise the necessary steps to prevent the recurrence of the problem.

Act → Repeat the process by considering Remaining problems or Improvement opportunities in the next planning stage.

Benifits of TQM.

- Improvement in product Quality.
- Improvement in product design
- Improment in production flow.
- Improvement in Employee morale & Quality Consciousness.
- Improvement in product Service
- Improvement in market place acceptance.
- Reduction in operating costs & operating losses
- Reduction in field Service Costs.

Inspection

Inspection is to Ensure Satisfactory Work in accordance with plans, specifications and good practice.

"Inspection is the process of measuring, Examining and Testing to gauge one or more Characteristics of a product or Service & the Comparison of these with Specified Requirements to determine Conformity."

Inspection is a first Stage of Quality management Inspection Came into Existence to check the product, to meet the Requirements of its Intended purpose before handing over to the Customer.

Inspection Can be done in 3 ways.

- Controlled → Verified / Inspected W.r.t Code Requirements
- Semi-Controlled → Materials not designated for C.I are Subjected to Semi Controlled Inspection.
- off-site Inspection → In Case where the Code provisions Require Inspection / test of materials are made up of off-site or prior to actual use or Incorporation into the work, the Inspector Shall mark and report the results of Such Inspection of materials.

Functions of Inspection Department [In construction Industry]

The Inspection department has to perform the following functions regarding the control of Construction work.

1. Inspection of Sub Soil
2. Inspection of materials.
3. Inspection of Equipment
4. Inspection of works at each stage.

Inspection of Sub Soil: It is necessary to test the bearing capacity of sub soil

Inspection of Materials: Supplies of materials for Construction work need to be inspected before they are used. Field and laboratory tests may be conducted for this purpose.

Inspection of Equipment: Supply of Equipment must be inspected before the items are recorded in books. Thereafter, regular periodical Inspections are necessary to ensure that the Equipment is kept in serviceable condition.

Inspection of works at each stage: The Inspector must inspect the work before the Contractor proceeds with the next stage.

Eg:→ Inspections are needed after Excavation has been completed.

→ Inspection of mixing and placing of Concrete is also necessary in some cases to ensure that the proper procedure is being followed.

Objectives of Inspection for an Organization.

1) To detect the faulty raw materials before it undergoes production.
2) To detect the faulty products in production whenever it is detected.
3) To bring facts to the notice of managers before they become serious to enable them discover weakness & over the problem.
4) To prevent sub-standard reaching the Customer and reducing the Complaints.
5) To promote reputation for Quality & Reliability of product.

Purpose of Inspection

1) To distinguish good lots from bad lots
2) To distinguish good pieces from bad pieces
3) To determine if the process is Changing.
4) To determine if the process is approaching the specification limits.
5) To Rate quality of product
6) To rate accuracy of Inspectors.
7) To measure process Capability
8) To Secure product - design information.

Need of Inspection for Construction work

1) Checking of building process and Evaluation of materials as per specification.
2) Standard of materials & Workmanship approved by the designer in the final working drawings and specifications.
3) Frequent Construction With the Contractor as per the Contract document.
4) The prevention of Errors & Workmanship of the Contract document.
5) The Skill full Co-ordination of the work of various person
6) To avoid Extra Construction Cost beyond the Estimated amount.
7) periodic Report on the progress of work/ project so that Supervising.

Types of Inspection

1. Floor Inspection
2. Centralized Inspection
3. Combined Inspection
4. Functional Inspection
5. First piece Inspection
6. Final Inspection.

① Floor Inspection

In this System the Inspection is performed at the place of production. This method of Inspection minize the material handling. It does not dis-rupt the line layout of machinery because it Suggests the Checking of materials in process at the machine.

Adv:→ Detection of errors of the Source Reduces Scrap & Network.

→ Material handling time is Reduced

→ Doesnot delay in production.

Dis Adv: → Delicate Instruments Can be Employed

→ pressure on Inspector

→ High Cost of Inspection because of numerous sets of Inspection.

② Centralized Inspection.

Inspection is Carried in a Central place with all Testing Equipments. This type of Inspection may locate in one or more places in the manufacturing Industry.

Adv: → Greater degree of Inspection due to Sensitive Equipment

→ Cost of Inspection Reduced

Dis Adv: → Greater material handling.

→ production Control work is more Complecated

→ Greater Scrap.

(3) Combined Inspection

Combination of two methods whatever may be the method of inspection whether flow or Central The main objective is to locate defect which may not repeat itself in subsequent operation to see whether any Corrective measure is required & finally to maintain Quality Economically.

(4) Functional Inspection.

This system only checks for the main function, the product is expected to perform. Thus any material can be checked for the specifications and Quality Characteristics.

(5) First piece Inspection.

First piece of the shift is inspected. This is particularly used where automatic machines are employed.

(6) Final Inspection.

This is also similar to functional inspection this inspection is done only after Completion of works. This is done in Conjection with Incoming material Inspection.

ISO Standards

Iso 9000 deals with the fundamentals of management Systems.

Iso: International Organization for Standardisation
It is located in Switzerland. Started in 1947
Goal: To have Common international standards.

The Iso: 9000 family Contains these standards which are Intended to provide the generic core of a Quality system standard applicable to a broad range of Industries & Economic Sectors. It outlines how a supplier Can Establish an Effective Quality System that will demonstrate Commitment to Quality and ability to meet Customer requirements.
The Iso 9000 family of standards is related to Quality management Systems & designed to help organizations Ensure that they meet the needs of Customers and other stakeholders while meeting Statutory & Regulatory requirements.

International standards promote International trade by providing one Consistent Set of requirements recognized around the world. Iso. 9000 Can help a Company Satisfy the Customers, meet Regulatory requirements and achiere Continual Improvement. It provides the base level of a quality Syetem, not a Complete guarantee of Quality. Originally published in 1987 by International Orgn for standardization

Iso, a specialised International agency for standerdisation Composed of the national standards bodies of 90 Countries.

Iso table for Construction Quality.

Iso 9000 : Explains fundamental Quality Concepts and provides guidelines for the selection & application of each standard

Iso 9001 : Model for Quality assurance in design; development; production, Installation and servicing.

Iso 9002 : Model for Quality assurance in the prodution and Installation of manufacturing systems

Iso 9003 : Quality assurance in final inspection & testing.

Iso 9004 : Guidelines for the applications of standards in quality management and Quality systems.

Iso 9000 and Iso 9004 are guidance standards. They describe what is necessary to accomplish the requirements outlined in standards 9001, 900 or 9003.

Iso standards in Construction.

Iso. 9001:2000 is the most widely used quality standard in Construction Industry.

Clauses

4.1 → Management Responsibility.
4.2 → Quality System.
4.3 → Contract Review
4.4 → Design Control
4.5 → Document & data Control
4.6 →
4.7 → purchaser Supplied product
4.8 → product Identification & Traceability
4.9 → process Control
4.10 → Inspection & Testing
4.11 → Inspection measuring & test Equipment
4.12 → Inspection & Test status
4.13 → Control of non-Conforming product
4.14 → Corrective & preventive action
4.16 → Quality Records
4.17 → Internal Audit
4.18 → Training
4.19 → Servicing
4.20 → Statistical Techniques.

Benifits / Advantages of Iso standerds

- Quality is maintained
- Can Increase Customer Confidence and Satisfaction
- opportunity to Compete with larger Companies
- More time spent on Customer focus
- Confirmation that your Committed to Quality
- May facilitate trade & Increased market opportunities.
- Iso Registration also has a significant bearing on market Credibility as well.
- Iso-9001:2000 has the Contents which includes Quality management System, management Responsibility, Resource mgt and product Realisation.

HSE; Introduction to Concept of Health, Safety and Environment in Construction Industry.

Health, Safety and Environment (HSE) is the department in a company or an Organis" Involved in Environmental protection, Saftey at work, occupational health & Safety, Compliance and best practices. EHS aims to prevent and reduce accidents, Emergencies and health Issues at work.

Safety Codes

IS : 3696 : Safety Codes for Scaffolds & ladder
IS : 3764 : Safety Codes for Excavation work
IS : 4130 : For demolition of buildings
IS : 4192 : For floor & wall opening, Railing
IS : 5120 : For piling and deep foundations
IS : 7205 : For Erection of steel structural work
IS : 8089 : For Erection of Concrete framed structure
IS : 4081 : For blasting and drilling operation
IS : 7293 : For Working with Construction maching

Importance of Safety in Construction.

The Construction Industry, Employing the labour force in the ~~Core~~ Country has accounted for about 11% of all occupational Injuries & 20% of all deaths resulting from occupational accidents. The Cost of accidents is Expensive. However, Economic Cost is not the only reason for which a Contractor should be Conscious of Safety.

- Life & property, public liability and Equipment Insurance rates are also affected by accident rates.
- Safe the Total Construction Cost
- Reduce workers Compensation Claims
- Improved Employee morale & Satisfaction
- Increased productivity.
- Reduced Insurance Cost.
- proper Management of Construction works
- Hazard Identification and Control.
- Reduced Expenses to Injuries & illness.

Safety in Construction is a prime requirement but it is often neglected on work site. The range of construction and building activities ~~act~~ Involvir complex techniques have led to many new problems of safety measures at site result in a better work environment, higher productivity and greater contentment among workers.

Safety measures

Prevention of accidents is a major aim of construction management, both for human and financial consideration. The nature of construction projects, accidents are likely to occur causing physical injury. In order to prevent accidents at construction site. Certain saftey measures are to be taken in the following major activities which are prone to risk of accidents.

1) Excavation
2) Drilling and blasting
3) Storage of materials.
4) Hot bituminous works
5) Scaffolding
6) Fabrication
7) Demolition.
8) Formwork and ladder.

Safety measures to be taken during.

1) Excavation

- At both Ends of Excavation Red flags and warning signs, Red lights or radium lights should be put
- Before doing the Excavation, a Complete knowledge of underground structures, such as Sewers, water pipe lines, gas mains etc. is Essential & Suitable precautions should be taken to prevent accident to the workers Engaged in Excavation work.
- Personal Safty measurements / Equipment's such as Safety shoes. Safety helmets etc. should be worn by all persons Entering a trench where hazards from falling stones or other material
- Workman to Excavate in trenches in Soft soil or fissured rock or hard soil Exceeding 2m in depth. The trenches should be Sufficiently shored & timbered.
- At the place of public fencing or barricades should be erected to avoid accidents. during nights adequate lighting should be provided.
- Excavated materials should kept away from the edge of trenches with a clear berm width of not less than 1/3rd the final depth of Excavation.
- Workers should be valved against the danger arising due to Sudden movement of materials

2) Scaffolding

- Scaffolding is a temporary and most essential Equipments in Construction work from masonry works to finishing.
- Every Scaffold should be firmly Supported or Suspended & properly strutted or braced to Ensure stability.
- It is needed when the work goes higher the Elbow level of worker, the only Equipment which can be used for doing contruction work safely is Scaffolding.
- In case of high winds the workes shouldnot be allowed to work or scaffolding
- If the platforms are not Suitable [like slippery] protecting cover should be provided.
- The plat form should neves be Supported on barrels and Empty drums
- While dismantling Scaffolding care should be taken to prevent injury to workers
- All the materials should be piled after, removing the nails.
- Care should be taken that there is no uninsulated Conducters with 3 m of platform.
- Defective Scafforlders should not be use
- The Gandway should always be lightened.

3) Drilling and blasting.

- Vehicles to be used for transporting explosives should be good in condition with tight wooden on non-sparking metal floor & sides.
- Explosives should be stored only in magazine which is clean, dry, well ventilated, & cool.
- Leaves, grass or broken pieces of any kind should not be allowed to accumulate within 8 m of magazine.
- No person should allow touching the wires and opening the bare leading wires of the electrical blasting caps during dust storms.
- Smoking should be strictly prohibited at places where explosive are used.
- Explosives & fuse lighters should not be stored in a damp or wet place or near oil, gas or steam pipes or other sources of heat.
- The rock blasting operations need to be kept isolated, free from men & Animals & proper watch & ward at all Entry / Exit points of approach roads shall be strictly adhered too.
- Before blasting all clear signal is given. After blasting operations, it is necessary to Check the Entire area of the Explosives, which shall be safely removed away from the work site

4) Hot bituminous works

- When bitumin plants are working on a public road, an adequate traffic Control System must be Established.
- Workers Engaged on Job Involving handling of hot bituminous works should use protective wares such as boots, gloves, goggles & helmets
- When bitumen plant is Established the safe means of access to working platforms, hand rails, pulleys belts and drive mechanism should be protected by suitable guards.
- Compressors, Electrical Installation and other Equipments such as Elevators & Conveyors should be adequately protected from weather, mechanical damage & dust particles.
- When heating and handling of hot bituminous materials is to be done in the open, sufficient stocks of clean dry sand or loose Earth should be kept ready at the work site to Cope with any resultant fire.
- An Experienced foreman or Supervisor should be made Incharge of the work to take guard against the use of defective / unsafe appliances Equipments & tools. He should keep stock of fire Extinguishing devices & first aid kits.

6) Form Work and ladder and other Equipments

* The Erection or dismantling of buildings, structure civil works, formwork and shoring should be carried out by trained workers only under Supervision
* Formwork should be designed, Constructed and maintained that it will be safely support all loads that may be imposed on it.
* Formwork should be so designed & Erected that working plat forms, means of access, bracing and means of handling and stabilising Equipments are fixed to the formwork structure.
* All form work should be properly designed
* Clear the Concise procedures to cover all stages of work should be prepared.
* A Competent person should be made without Consulting the Coordinator
* All Adjustable shoring should be locked in position when adjusted.
* Shoring should be arranged so that when it is being removed Sufficient propes be left in place to afford the support.
* To prevent danger from falling parts shuttering is being taken down.
* Proper lifting Appliances are to be Checked & Implemented

5) Ladder

- All wooden ladders or bamboo ladders must be strong enough
- Ladders in heavy duty work should not Exceed 6m in length, for light work it should not exceed 8m in length.
- All persons handling Construction Equipments should be fully acquinted with all safty aspects of machines & their opeeations.

6) Safty in Storage of Materials

* Adequate fire fighting arrangements should be provided at site particularly in areas where petroleum products and timer are stored.
* Explosives must be stored in proper magazines and the prescribed safety measures for handling and Storage of Explosives should be observed.
* Petroleum products should be separately stored. Smoking and other fires should be strictly prohibited where these products are stored. only required Quantities of such products should be stored at site.

It is a basic principle that all building materials must be stored in such a manner as to prevent deterioration of intrusion of foreign matter & to ensure the preservation of their quality & fitness for use.

Materials stored at site depending upon the individual characteristics and they should be protected from atmospheric effects due to rain, sun, wind or moisture to avoid deterioration. Sufficient precautions must be accorded against fire, timber, coal, paint & explosives etc.

i) Cement : * Cement bags should be placed in stacks or on raised platform, dry & impervious to water, with adequate waterproof, roof covering and at least 30 cm clearance from any wall.

* Stacks should not be more than 12 bags high where bulk handling of cement is undertaken.

* protective mask should be provided to the workmen

ii) Lime : * Lime should be stored in suitable shed to protect it from dampness

* It should be stacked against wall

* keep it safely as it deteriorates by absorption of moisture from atmosphere.

iii) Masonary units or bricks

* Bricks should be stacked at site on level ground in not more than 1.5 m in height.
* Bricks of different types & classification should be stacked seperately.
* Similarly stone blocks & concrete blocks should be stored in stacks avaiding toppling of stacks as well as crushing of the lowest layer blocks

iv) Aggregates

* Fine aggregates like sand, surkhi, cinder & coarse aggregate like stone chips, brick ballast should be stacked on hard surface or platform in such a way to prevent the admixture of clay dust, vegetable & and other foreign matter.

v Timber

* Timber should be piled in stacks above the ground level by at least 15 cm with an airspace of about 2.5 cm round scantings
* The width and height should not exceed 2m and distance by adjacent stacks must be 60 cm & atleast.
* The stacks must be protected from hot dry wind or direct sun or rain.

vi) Steel

* steel Reinforcement should be stored in a way to prevent distortion and Corrosion. It is desirable coat Reinforcement with Cement wash before Storing to prevent Scaling and Rusting.
* For moving heavy Steel Sections Suitable handling Equipment should be provided and workmen should never be allowed to lift with bare hands or carry them on shoulders.

vii) Door, window frames : Metal frames, Alluminium frames, wooden frames & prefabricates of doors and windows should be stored in upright position adopting Suitable measures against risk of Subsidence of soil/support.

viii) other materials : Small articles like Screws, nuts, doors & windows fittings, watersupply and fittings (sanitary), Electrical fittings should be kept in Suitable and properly protected Containers seperate in store rooms.

Safety through Legislation.

In Construction Industry the legislation is needed for Improving the working condition, Determing the terms of employement providing soial Security and Regulating the Relationship between Employees & Employer Safeguarding the lifes of workman for the welfare of workers. Indian government as promulgated number of legislation from time to time to adress saftey aspects of Construction work. Some of legislation are as follows.

1) payment wages act – 1936.
2) Minimum wages act – 1962
3) Workmen's Compensation act – 1923
4) Industrial dispute act – 1967
5) Indian trade union act – 1926.
6) Factories act – 1948
7) Interstate Migrart labour act – 1973.
8) Mines act – 1952
9) Indian Explosives act – 1984
10) Indian boilers act – 1923
11) Petholium act – 1934
12) Contract labour act – 1970
13) Building & other Construction work act – 1996
14) Occupational Safety & health act – 1970.

Understanding the legislations alone cannot Ensure Safety in Job Construction / operation all of us effective approch towards prevention

of accedents & promotion of Saftey Consciou is achieved and ~~atter~~ alertness levels are Increased to practice safe working habits, the rules and regulations remain the paper. Saftey should be Set up as an objective as Implement as Economic gains & Zero accidents in Job performence should be motive. The Safe working practices should be rewarded & hailed within the organizati

unsafe work site and unsafe work behavior leads to accidents. An accident is an unplanned, unwanted, undesiarable sudden mishapping which Interrupts an activity or a performence. The losses on accident of unsafe working practies reduces output, wasted wages, lost time, lowered morles, damaged property, loss of Experienced hands, medical bi an above all lox of good will. Accidents added up Employer hoorries. Safety should be builder's first responsiblity Since controlling of accidents reduces the Saddest product - human Scrap. Safety has always paid rich dividents in Construction works.

Central public works department have their own Saftey codes on the lines of ILO Code.

* FASLI - Factry Advisory Servic & labour Institutes, Govt of India.
* NICMAR - National Institute of Construction management & Research.

* NITIE – National Institute of Industrial Engineering
* ILO – International Labour Organisation.
* WHO – World health Organisation.

ILO & WHO are the 2 organisation in the world which cater to the Safety provisions & helth Concern of working class.

OSHA – Occupational Safety & Helth Administration [1970].
has made tremendous Contribution with Respect to minimum wages Safety leave aspects & welfare of the Employees in the Construction industry.

Legislation in other Countries.

(1) U.S.A – OSHA – 1970
(2) UK – Health & Safety work Act – 1974.

Major Areas of Concern are as follows.

* Safety policy
* Operational branches for factory Inspection
* Hazardus Substance policy.
* Research and planning
* Accident prevention advisory unit.

(3) * Sweden – Swedish Employers Confederation (SAF)
(4) * ~~Switzerland~~ – Federal Republic of Germany
Germany – Industrial mutual accident Insurance association.
(5) Switzerland – Federal ~~Republic of Germany~~ department of Economics.

Safety Campaign.

Safety Campaign aims to reduce the number of injuries sustained by workers performance regarding basic Construction work. Guidelines of national saftey Consists towards safe working practices should be predominently displayed at work spot & precautions to be taken to avoid accidents. safty work with visual presentations should be arranged at least once in a month and all the workers need to be educated to become aware of value of saftey in Engineering works. use of protective clothing, safety helmets, face shields, safety Equipment's for eyes, ears, hands, feet, legs should be widely advertised and scrupulously followed. safe working Employees should be rewarded & awarded to rise the awareness levels among others.

Insurances

Def': A Contract (policy) in which an Individual or Entity recives financial protection or Reimbors -ement against losses from an Insurance Company. The Company pools clients risks to make payments more affordable for Insured.

Characteristics :) It is a Contract for Compensating losses

e) Premium in charge for Insurance Contract

s) It is a Contract of good faith

4) The payment of Insured as per terms of agreement in the event of loss
5) It is the Contract of good faith.
6) It is a Contract for mutual benefit
7) It is a future Contract for Compensating losses.
8) It is an Instrument of distributing the loss of few among many
9) The occurance of loss must be accidential
10) Insurance must be Consistent with public policy.

Nature of Insurance

1) sharing of Risk
2) Co-operative device
3) Valuation of Risk
4) payment made on Contingency
5) Amount of payment
6) Large number of Insured persons
7) Insurance is not gambling
8) Insurence is not Charity.

Functions of Insurance.

1° fun: provision of Certainity of payment at the time of loss
provision of protection risk sharing.

2° fun: prevention of losses, Improvement of efficiency
provision of Capital, ensuring welfare of society

To mitigate these kind of uncertainities or unforseen events an Insurence cover is normally taken, following are the relevant schemes on engineering project works.

1) Contractors All risk Insurance (CAR policies)
2) Machinery breakdown Insurance
3) Loss of profit Insurence following machinary breakdown
4) Contractor's plant & machinery Insurences.

Contractors all risk Insurance (CAR policy).

This is a Comprehensive Insurance Cover & provides adequate protection against loss of damages in respect of Contract works, as well as third party claims towards property damage or badly injuries workman/general public.

Insurance Coverage on all risk Encompasses any sudden and unforeseen loss or damage occuring to the property Insured. The following items get covered in CAR policy under normal circumstances

- Fire accidents, lighting and Explosives
- Theft, burglary
- Bad workmanship, unintentional negligence, human errors
- Natural Calamities (food, earthquakes etc) if specifically provided in Insurence terms

unless otherwise specified, the following are not included in the CAR policies

↳ loss of damage due to war or war like operations, strikes riots.

↳ Loss or damage due to willful negligence

↳ Loss due to nuclear reactions, radiations, radio-active contaminators.

For Labour Intensive Contracts - normally the Contractor is expected to take Group Insurance Cover / workman Compensation polices to specifically protect the helth and other employees / supervisors (Including Consultants) are generally not Covered in CAR policies or which the owner shall take separate Insurance cover.

Machinery Breakdown Insurance

Normally this type Insurance Covers Installed working in fixed premises. In special Cases the Insurance Cover can be Extended to Include equipment's in transit and damages to third parties as well as personal injuries arising out of breakdown of Insured machinery.

Loss of profit Insurance

Following breakdown of machinery or loss of profits due to non-operations, malfunctioning of some small Control parts, the functioning of the Entire machinery Comes to stand still.

In such cases, this policy covers Consequential losses suffered by the machine user. Sometimes machine repair may take long time; in such cases machinery breakdown Insurance policy above covers machine repairs cost & this policy entitles him or Consequential losses / profit losses.

4) Contractor's plant and machinery Insurance CPM policy.

CPM is a special Insurance policy cover due to non-production plant & machinery not attributable to Engineering reasons but to other factors such as riots, Strike, malicious damages, breakdown due to Excess running's etc. However this policy doesnot Cover Electrical / machinary breakdowns, ~~not~~ normal wear & tear, war / nuclear reactions. The this policy number of Equipment's or period can be changed periodically keeping some minimum stock.

Morals

Morals are the Guiding principles that every Citizen should hold. It is the foundational Concepts defined at both Individual & Societal level. At the most basic level, morals are the knowledge of difference b/n the right and wrong.

Moral values are relative values that protect life and are respectful of the dual life value of self & others. The Great moral values such as truth, freedom Charity etc have one thing in Common when they are functioning Correctly, they are life protecting or life Enhancing for all. Morals are the welfare principles Enculcated by the wise people based on their Experience & wisdom. They were edited, changed or modified or evolved to suit the Geography of the region, rulers and in alk with development of knowledge in Science and Secualogy with time

Morality is Concerened with principles & practices

- what ought or ought not to be done in given Situation
- what is right or wrong about the handling of Situation
- what is good or bad about the people, policies and Ideals Involved

Eg: Do not Cheat, be honesty
Always tell truth, don't hurt others.

Values

The word value is derived from French word "Valoir" which means worth, merit, usefulness or importance of a thing. values are Individual in nature.

values are Comprised of personal Concepts of Responsiblity; Entitlement & Respect. values are shaped by Experience, may change over the span of lifetime and may be Influenced by lessons learned. values may vary according to an Individual's Cultur, Ethnic and/or faith-based background. Integrity is one such value. A/c to dictionary values are "things that have an Intrawic worth in usefulness or Importance to the possessor or principles, standards or qualities Considered worthwhile or desirable. values are qualificed by asking "How is it good? or Good to whom?"

Characteristics of Values:

- values Represent an Individual's highest priority and deeply held driving force.
- values ar the hub of personality & is powerful force affecting behavior.
- Valves varies according to time.
- Many values are Relatively Constant & durable
- It Contains a Judgement Element.
- Everyone does not hold the same valve

"Values are the principle that promotes well being or prevents harm" values are our guide lines for our success - our paradigm about what is acceptable"

Evolution of human values

The human value Evolves because of the following factors.

* The Impact of norms of the Society on the fulfillment of the Individual's needs or desires
* Developed or modified by one's own awareness, Choice & Judgement in fulfilling the needs.
* By the teachings & practice of Saviours or Religious leaders.
* Fostered or modified by social leaders, rules of kingdom & by law
* Values are distinctly different from Comforts. Comforts bring in short term gains & long term ~~gains~~ pains where as values bring short term pains & long term gains.

Ethics

Ethics are widely accepted principles of right Conduct. Ethics are more practical, Conceived as overarching principles promoting fairness and forming the basis of Criminal Jurisprudence.

one can say that morals are those fundamental values that are Endorsed by a higher authority and ethics are values which are based on gretles objectivity and are geared towards Ensuring smooth day-to-day functioning.

Definition: Ethics is a branch of philosophy that deals with the principles of Conduct of an Individual or group. It works as a guiding principle as to decide what is good or bad. They are the standards which governs the life of a person.

Ethics is also known as moral philosophy.

Ex: Truthfulness, Respect, Honesty, fairness loyalty, Integrity.

If the son of a big politician has Committed a crime & he uses his powers to free his son from legal Consequences. Then this act is Immoral because the politician is trying to save a Culprit.

Charecteristics of Ethics

* Ethics are the principles, which govern and guide people to perform functions & in that sence "Ethics" is a discipline
* It is Considered both as a Science & art.
* It Continuosly test the Rules & moral standards & is dynamic in nature
* It is based on theological principles Such as Sincerity, human welfare
* It is based on Reality & Social outcomes prevailing in business Environment.
* It studies the activities, decisions and behavior which are related to human beings.
* It is universal application because business Exists all over the world.
* Many of the ethical principles develop the personal dignity

Code of ethics

* Code of ethics is a frame work for arriving at good ethical choices.
* The Code of ethics Establishes a frame work for ethical Judgment for any profession.
* A Code of ethics doesnot develop new moral principles.

Difference b/n Morals & Ethics

Point of Comparision	Morals	Ethics
Meaning	Morals are the beliefs of the Individual or group as to what is wrong or right.	Ethics are guiding principles which help the Individual or group to decide what is good / bad.
Governed by	Social & cultural norms	Individual or Legal & professional norms.
Applicable in business	No	Yes
Consistency	Morals may differs from society to society & Culture to Culture	Ethics are uniform.
Expression	Morals are expressed in the form of general	Ethics are abstract
Freedom to think & Choose	No	YES.

Work Ethics / Business Ethics

principles of business ethics

* Sacredness of means & Ends
* not to do any evil
* principle of proportionality
* publicity
* Equivalent price
* Human dignity
* Non- violence.

Advantages of Work Ethics.

Work Ethic is a belief that hard work & diligence have a moral benefit & an inherent ability, virtue or value to strengthen Character & Individual abilities. It is a set of values Centered on Importance of work & manifested by determination or desire to work hard.

* Significant Improvement to Society.
* Cultivate Strong team work & productivity.
* Support Employee Growth
* Avoid penal action
* Insurance policy.
* Helps in Quality management Strategic planning & diversity Mgt.

Industry & society are two systems which Interact with each other and are Interdependent. To Communicate the system — Ind & Socty — work Ethics plays an Essential role.

Work Ethics defined as a Set of attitudes Concered with the value of work, which forms the motivational Orientation.

* It is a Set of values based on hard work & diligence
* Work ethic may Include being Reliable, having Initiative or pursuing new skills.
* The work Ethics aimed at Ensuring Economy, productivity (wealth, profit), safety Health & Hygine (Cleaning Condition), privacy (raise family), Security, welfare (social work) Environment (anti pollution)

* Workers who fail to Exhibit a good work ethic may Regarded as failing to provide fair value for the wage the Employer is paying them and should not be promoted or placed in positions of greater Responsibility.

* Work Ethic is not Just hardwork but also a set of accompanying virtues whose Crucial Role in the development & Sustaining free markets

Engineering Ethics

Engineering ethics is the study of moral issues and decisions confronting individuals and organizations involved in Engineering. Engineering ethics is the study of related questions about moral ideals, character, policies and relationship of people and organizations involved in Technological activity

Engineering ethics is comprised of some sets of beliefs. Moral principles and rules that determine what is right and what is wrong or what is good and what is bad in the Engineering profession which are commonly applied to all Engineers

Two Important ethical Codes that Engineer must be aware of NSPE – National Society of professional Engineerts Code of Ethics

and

ASCE – American Society of civil Engineer Code of ethics formulated the 'Code of Ethics' for Engineers. This codes are sets of rules that Clearly lay out the ways that professional Engineers must Conduct themselves in workplace. These Codes are not merely guidelines, but in fact are legally binding. If an Engineer is found violating one of these Codes, they must lose their license & Could possibly face legal Charges.

Ethical Issues faced by Engineers are

* Bribery & Fraud
* Fairness
* Conflicts of Interst
* Honesty in Reserch & Testing
* Environmental protection.
* Public Safety.

Need of Engg. Ethics : Engg Ethics is not only teaching moral behavior in knowing about Immoral & moral in set of beliefs, but also Increasing the ability of Engs & other professionals to face boldly with moral problems arising from technological advancements.

* Engg ethics Increses awareness
* Gives Importance due to publicity Surrounding high profile Engineering failures.
* It can Impact public health, Safety, business practices and politics.
* Engineers should be aware of moral Implications as they make decisions in the workplace
* study of ethics helps Engineers develop a moral durability
* Ability to think critically & Independently about moral Issue
* Ability to apply this moral thinking to situation that arise in course of professional Engineering practice
* It makes an engineer to resolve these Conflicts and reach a defensible decision.

Integrity

This principle Embodies a Sentiment Expressed earlier in the paper in recogniding the overall objective of Construction being the production of safe reliable, ~~ree~~ useable & affordable Construction. This is only achievable if the professionals Concerned Can look beyond their own or their Clients narrow agenda.

Integrity is defined as the unity of thought word & deed Chonesty) & open mindness.

It Includes the Capacity to Commonicte the factual Information so that other can make well-Informed decisions. It yields the person's peace of mind & Hence adds strength and Consisteney in charecter, decisions & actions. Integrity Comes in many forms but honesty and dependability are two trails that are Expected in most workplace Situations without Responsible behavior, distrusts which make a work Environment tense & uncomfortable.

Eg: of Integrity at work place

- work when you are on the Clock
- Follow Company policies
- Respect Co-workers & Build trust
- Exhibit Responsible behavior.

Professional Rights

1) The Right to Engage in the activities of professional Societies.
2) The Right to form and Express one's professional Judgment freely.
3) The Right to talk about one's work within bounds set by Confidentiality obligation.
4) The Right to protect the Clints and the public from the dangers that might arise from one's work.
5) the Right to professional Recognition of one's Service
6) The Right to refuse to Carry out illegal and unethical activity.

Induvidual Rights / Employee Rights

Employee rights are any rights, moral or legal that Involve the status of being an Induvidual Employee.

Rights are.

1) The Organization will not discriminate against a Employee for Engaged in outside activities or for objecting to an Organization directive that violates Common norms of morality.
2) The Employee will not be deprived of any Enjoyment of reasonable privacy in his/her workplace.

3) No personal Information about Employees will be collected or kept other that what is necessary to manage the organisation Efficiently and to meet the legal Requirements.

4) There should be no discrimination against an Employee for criticizing ethical, moral or legal policies and practices of the Organisations.

5) No Employee who alleges her/his rights have been violated will be discharged or penalised without a fair hearing by the Employer organisatio

Confidential and proprietary Information.

Information Considered desirable to keep secret any Information that the Employer or client would like to have kept Secret in order to Compete Effectively against business rivals. This Information Includes how business is ron, its products, suppliers which directly affects the ability of the Company to Compete in the market place. Helps the Competitor to gain advantage or Catch up.

Information that a Company owns or proprietor This is primarily used in legal sense also called Trade Secret. A trade Secret Can be virtually any type of Information that has not become publi and which an Employer has taken steps to keep Secrete.

Proprietary Information is Information such as financial data, test results or trade secrets that is viewed as the holder's property and that they wish to keep from becoming public knowledge. For Information to be Considered proprietary, it should not be readily available in public source. It is provided to a advantage & the Company should take every Resonable step to maintain its Confidentiality. This may Include the developing Security system to protect proprietary Information from the Increasing threat of Cyber-hacking. More Companies are now appointing Information managers to assume responsibility for keeping Information Safe and Secure. This Can be an Issue on Const' project, where Members of project team, client may learn Information that one party who wishes to stay Confidential. Submitting tender proposals for example may require the provision of detailed Cost Information. and descriptions of Technologies and methodologies. This may Include Information that Suppliers would not wish to be Shared with their Competitors.

Confidential & propoietary Information Can be used to prevent Commercially Sensitive Information from being shared, or to prevent parties from Communiting certain Information to the press or other third parties.

Conflict of Interest Confidentiality.

Confidential Information is Information deemed desirable to keep Secret. Engineers are Required to keep Confidential Certain Information belonging to their Employer or Client Such Information. If released, might allow other Companies or Organisation to gain an unfair Competitive advantage.

"A Conflict of Intrest" is a Situation in which a person. such as a public official, an Employee or a professional, has a private or personal Interest Sufficient to appear to Influence the objective Exercise or his or her official duties

Employees are not allowed to Engage, either within or outside working hours, in any other gainfull Employment or Conduct any form of business activity, either personally or through the agency of another, unless prior approval is obtained from the managing director and Hr. Dept. Any Violation to this regulation is Cause for dismissal.

Conflict of Interest arises when two Conditions are met

1) The professional is in a relationship or a role that requires Exercising good Judgment or behalf of the Interests of an Employer or Client &

2) The professional has Some additional or side Intrest that could threaten good Judgment in Serving the Intrests of the Employee or Client.

Conflict of Interest arises when

a) Created by Interest in other Companies. [outsider]

- one works actually for the Competitor or Subcontractor as an Employee or Consultant.
- Having partial ownership or Substantial works in stock holdings in the Competitor's business.
- It may not arise by merely having a spouse working for Sub-Contractor to one's Company. but it will arise if one's job also Includes granting contracts to that Subcontractor.
- Tempting Customers away from their current Employer, while still working for them to form their own competing business.
- Moonlighting usally Creates Conflict when working for Competitors, Suppliers or Customers, Supplies or Customers but does not Conflict when working for others without affecting the present Employeer's business.

b) Conflicts of Interest Created by Insider Information

- Using Inside Information to Set up a business opportunity for oneself or family

- Buying stock in the Company for which one works is not objectionable but it should be based on the same information available to the public.
- The use of any Company secrets by Employee to secure a personal gain threatens the Interest of the Compay.

Trustworthiness

Trustworthiness is a human quality and virtue Trustworthiness; Enable others to believe in us & to rely on us without reservation or fear. The following value or qualities help us develop trustworthiness; honesty, intergrity, reliabity & loyalty

Honesty is a value that helps us Convey the truth as best as we know it. Honesty help us avoid Communication that is misleading or deceiving. There are different ways to build honesty. They are

* Truthfullness
* Sincerity
* Candor.

Integrity and trustworthiness are Important Concepts in the Social Sciences, because each is said to Enable and enhance Co-operation.

Trustworthiness is a Component of trust that relates to the personal attributes of a trustee such as their Credibility, benevolence, Competence & Integrity.

Gift and Bribe

Something offered or given to someone in a position of trust in orders to induce him/her to act dishonestly.

If you think that any offer of acceptance of a particular gift would have grave or merely embarrassing consequences for company if made public, then the gift should be considered a bribe. Bribe can be said to be a substantial amount of money or goods offered beyond a stated business contract with the aim of winning advantage in gaining or keeping the contract. Here 'substantial" means that which is sufficient to distort the judgement of typical person.

Eg: of bribery.
Employing a public officials son to influence the award of contract.

Gift is something given voluntarily without payment in return, as to show favor towards someone, honor an occasion, or make a gesture assistance motivation behind giving gift: In some business cultures, gifts are means of cimenting relations and are given without influencing decision-making

Eg: Companies offer gifts to their customers in order to acknowledge their loyalty to the Compan and ultimately to enhance relationship b/n customers.

Price fixing.

A practice where by rival companies come to an illicit agreement not to sell goods or services below certain price.

An Act was passed, which forbade (prevented) companies from jointly setting prices in ways that restrain free competition and trade. Price fixing is when two entities, usually companies, agree to sell a product at a set price. They do this to maintain profit margins. It's easiest for monopolies to fix prices. They operate without competitors that could offer products at lower prices.

Whistle blowing.

Whistle blowing is an act of conveying information about a significant moral problem by a present or former employee.

The features of whistle blowing are

① Act of disclosure ② topic ③ Agent ④ Recipient

① Act of disclosure : Intentionally conveying Information outside approved organisational channels when the person is under pressure not to do so from higher-ups

② Topic : The Information is believed to Concern a significant moral problem for the Organisation

⑤ Agent: The person disclosing the Information is an Employee or former Employee

④ Recipient: The Information is Conveyed to a person or organization who can act on it.

Types of whistle blowing

1) External whistle blowing: An act passing on Information outside the organization.

2) Internal whistle blowing: The act of passing on Information to someone with in the organization but outside the approved Channels.

3) Open whistle blowing; Individuals openly revealing their Identity as they Convey the Information

4) Anonymous whistle blowing: Individual Conveying the Information Conceals his/her Identity.

Whistle-blower:

Whistle blower is someone who finds out that the illegal happening in the Organization and Informs which are deemed illegal, unethical or not Correct within an Organization that is either private or public.

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Module - 4

Introduction to Engineering Economy:

Principles of Engineering economics, Concept on Micro & macro analysis, problem solving & decision making.

Interest and Time value of Money.

Concept of Simple & Compound Interest, Intrest formula for; Single payment, Equal payment and uniform gradient Series. Nominal and Effective Intrest rates, deffered annuities, Capitalized Cost

Comparision of Alternatives

present worth, annual Equivalent. Capitalized and Rate of Returns methods. - 16 page.
Minimum Cost analysis & Break even analysis.

Introduction to Engg Economy.

Efficient functioning of any business organisation would enable it to provide goods/services at a lower price. In the process of managing organisations the managers at different levels should take appropriate economic decisions which will help in minimising Investments, operating and maintence Expenditures, besides increasing the Revenue, savings & other gains of Organisation. This Can be achived by Engg. Economics which deals with methods that enable one to make economic decisions towards maximising costs & / or maximising benefits to

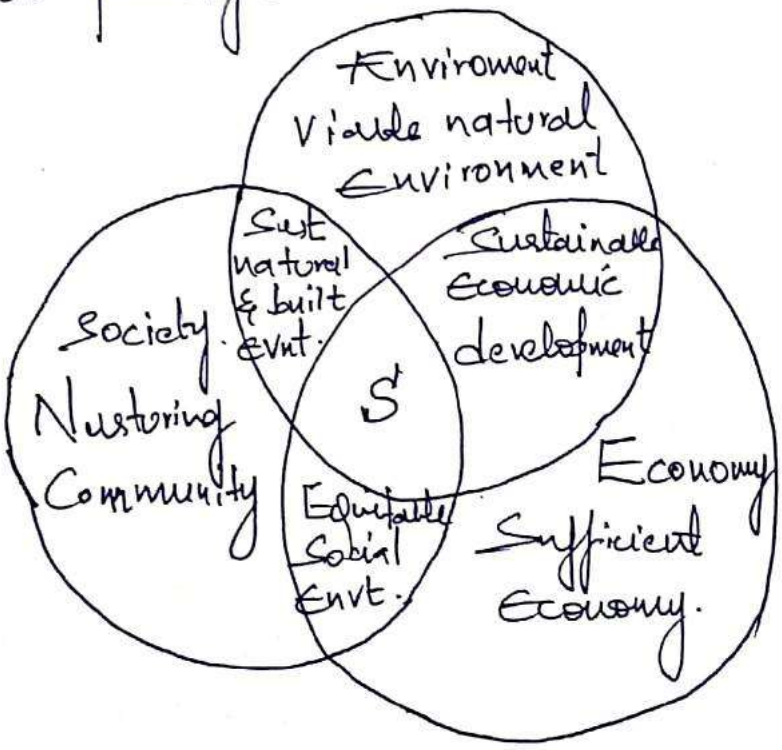
business organizations. This is followed by an analysis of the need and scope of engg economics.

Definition of Economy

Careful Management of available resources the state of a Country or Region interms of production and consumption of goods & Services and the supply of Money.

(or)

Economy is defined as the Management of financial Matters for a Community, business or family.



S → Sustainability.

Engineering Economics or Engineering Economy.

"It is a subset of Economics concerned with the use and application of Engineering decisions."

As a discipline, it is focused on branch of Economics known as Micro Economics in that it studies the behavior of individuals & firms in making decisions regarding the allocation of limited resources.

Engineers seek solutions to problems and Economic viability of each potential solution is considered along with technical aspects. Engineering Economics involves formulating, estimating and Evaluating the Economic outcomes when alternatives are their to accomplish a defined purpose.

Principles of Engineering Economy.

The development, study & application of any discipline must begin with a basis of principles of Engineering Economy.

The following are the seven principles

① Develop the alternatives : It involves the Engineer to identify, define, innovate & creativity in any project for its Economy Mgt.

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① Develop the alternatives : It involves th Engineer to identify, define, innovate & creativity in any project for its Economy Mgt.

② Focus on the differences : Engg. Economy suggests the major principle to focus on differences in the future outcomes of all developed alternatives.

③ Use a Consistent Viewpoint : In Economy study of any project the prospective outcomes of all the alternatives be Considered in a Consistent viewpoint.

④ Use a Common Unit of Measure : As Economy is Monetary (Related to Money), it is required to use a Common unit of Measure. (usually USD, INR) Monetary presentation of the alternatives & their outcomes be Considered.

⑤ Consider all Relevant Criteria : Decision making based on several Criteria. (Sel" of preferd alternatives)

⑥ Make Risk & Uncertainity Explicit : It is also required to make the risks & uncertainities of any project or System very clear or detailed. It is done by identifying, defining, allocating & Mitigating the risks & Uncertainities.

⑦ Revisit your decisions : The Initial projected outcomes of the selected alternatives should be subsequently Compared with actual results achived.

Improved decision making results from an adaptive process; to the Extent practicable.

Engineering Economic analysis procedure.

① problem recognition, definition & Evaluation.

problem must be well understood & stated in an Explicit (detailed) form before the project team proceeds with the rest of the analysis

② Development of feasible alternatives.

Searching for potential Alternatives (creativity and resourcefulness) Screening them to a selection of smaller group of feasible alternatives for detailed analysis.

③ Development of the outcomes and Cash flows

Cash flow approch (revenue & payments), non monetary factors ex: Meeting or Exceeding Customer Expectations, Safety to Employees, Employees satisfaction etc.

Concept on Micro & Macro Economics.

Micro-economics: It is the study of Markets & Segments of the Economy. It looks at Issues such as Consumer behaviour, individual labour markets & the theory of firms.

Micro Economics is Concerned with

↳ Supply & demand in Individual markets
↳ Individual Consumer behaviour eg: Consumer choice
↳ Individual labour Market - by demand of labour & product demand in the market.

Macroeconomics : It is the study of the whole Economy. It looks at 'aggregate' variables such as aggregate demand, national output & Inflation.

Macroeconomics is Concerned with.

→ Monetary / fiscal policy
→ Reasons for Inflation & unemployment.
→ Economic growth
→ International trade & Globalisation.
→ Reasons for differences in living standards and Economic growth b/n Countries.
→ Govt. borrowing.

Difference b/n Micro & Macro Economics.

Micro Analysis / Economics	Macro Analysis / Economics
1) It deals with the decision Making of single Economic variables such as demand, price Consumer etc.	1) It deals with averages & Aggregates of the Entire Economy such as national income Aggregate output, Aggregate Savings etc.
2) It is narrow in scope and Interprets the Small Constituents of the Entire Economy.	2) It has a wide scope and interprets the Economy of a Country as a whole.

Micro Economics

3) It is also known as the price theory because it Explains the process of Economic resources allocation on the foundation of relative prices of several goods & services.

4) It deals with the flow of production from a single owners to a single user of those resources

5) It helps in developing policies appropriate resource distribution at firm level.

Macro Economics

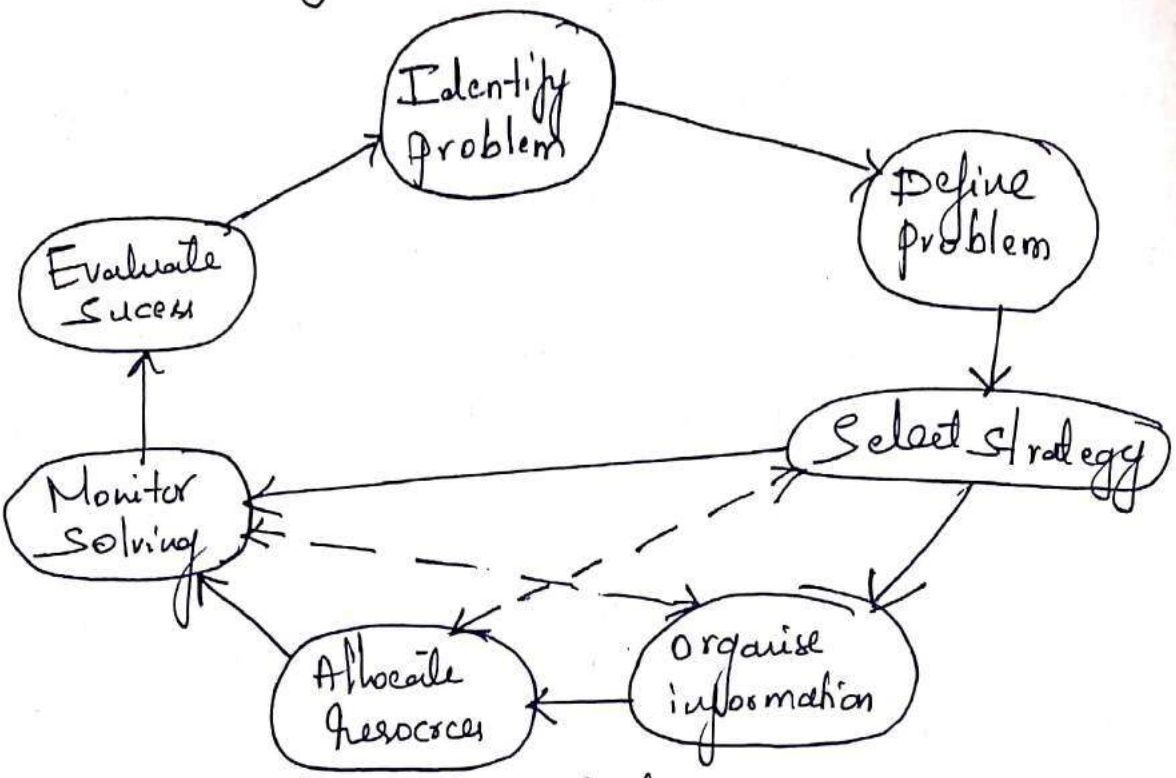
3) It is also known as the income theory because it Explains the Changing levels of national income of an Economy during a period of time.

4) It deals with the Circular flow of Income and Expenditure b/n different Sectors of Econom

5) It helps in developi policies appropriate resou distribution at Economi level such as Inflation unemployement level etc.

Problem Solving and decision Making.

Problem Solving process



Problem Solving Cycle

Problem Solving and decision making is the major step or process to be done prior to Conduct the different future activities in any organisation or project for better Conduction of Company, So that the risks and uncertainities Can be avoided if the problem Solving process & decision making process is done by Considering all future Constraints well in advance.

7 steps for an Effective problem Solving process.

① Identify the Issues.

Be clear about what the problem is, Remember that the different people might have different views of what the issues are... Separate the listing of issues from identification of Interests.

② Understand or define problem / understand everyone's interest in the orgn or in project or team. by Choosing best solution that satisfies everyone's Intrest

③ List the possible Solutions (options)

There may be lots of room for Creativity that separate the listing of options from Evaluation of options.

④ Evaluate the options : what are the pluses & minuses separate the evaluation of options from the selection of options

⑤ Select an option or options

What's the best option in the balance? Is there any way to bundle a number of options together for more satisfactory soln?

⑥ Document the agreements

Documentation of all aggrements involved in the project.

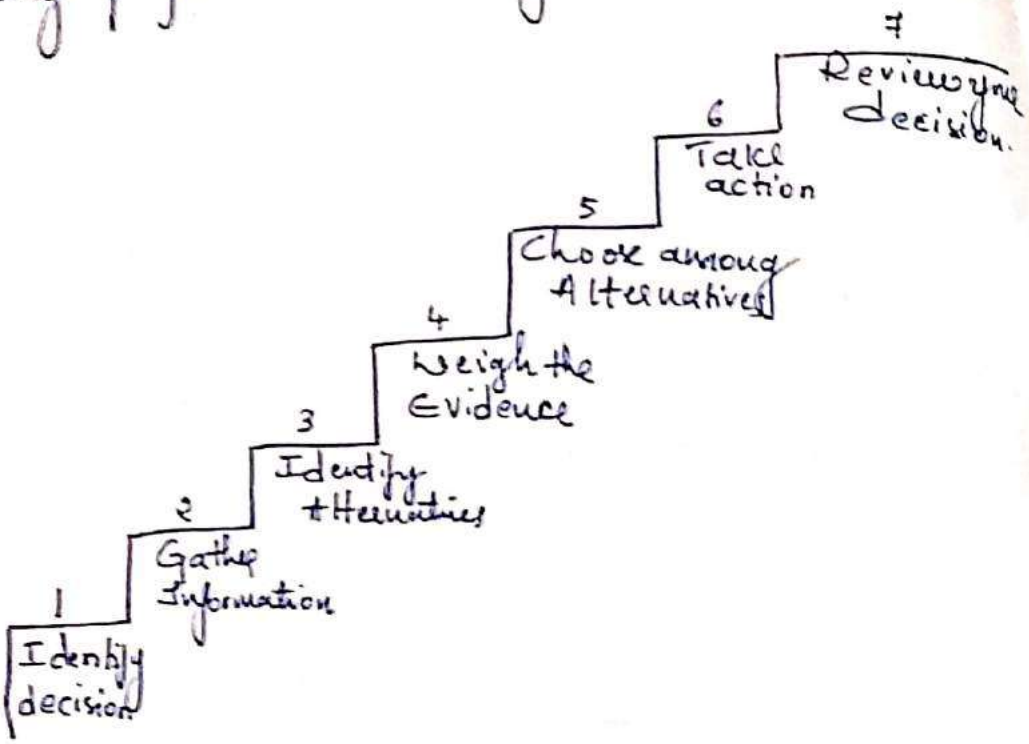
⑦ Agree on Contingencies, Monitoring & Evaluation.

Conditions may change, make Contingency agreements about foreseable future Circumstances. Create opportunities to Evaluate agreements & their implementations.

Effective problem Solving does take sometime and attention but very less time & attention than is required by a problem not well Solved.

Decision Making.

Managers in Organisations often need to take decisions based on Concequences. Following are the 7 Steps to be followed for an Effective decision making in any project or an Organisations



Step 1 : Identify the decision : You Realise that you need to make a decision. Clearly define the naiture of decision you must make. This is very Imporatant.

Step 2 Gather Relevant Information. Before you make your decision what Information is needed, the best Sources of Information and how to get it. This step Involves both Internal and External work. Internal and External Information to be Gathered.

Step 3 Identify the Alternatives : As we Collect Informa we can probably identify Several possible paths of action or Alternatives. we can also use our Imagination and additional Information to Construct new alterna

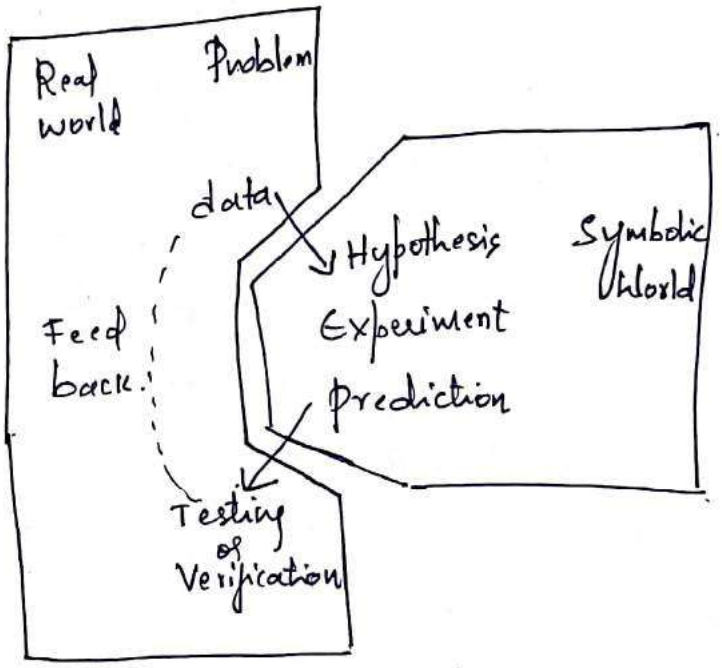
Step 4: Weigh the evidence: Draw on your Information and Emotions to Imagine what it would be like if you Carried out each of alternatives to the End. Evaluate whether the need identified would be met or resolved through the use of each alternatives. The alternatives those have higher potential for leading the goal. Finally, place the alternatives in a priority order based upon your own value System.

Step 5: Choose Among alternatives: Once you have weighed all the evidence, you are ready to select alternative that seems to be best one for you you may even choose a Combination of alternatives your choice in step 5 may very likely be the same or Similar to the alternative you placed at top of your list at End of step 4.

Step 6: Take Creatio action.: It is now ready to take some positive action by beginning to Implement the alternative you've chose in step 5.

Step 7: Review your decision & its Consequences. In this final step, Consider results of your decision and evaluate whether or not it has resolved the need you Identified in Step 1. If the decision has met the identified need, you may want to repeat Certain Steps of process to make a new decisions.

The Fundamental approach to problem Solving is Scientific methods. It use both thiretical & practical knowledge to Solve the Same. It takes real world facts and figure & Symbolic world of theories & hypothesis to Solve problems through an iterative process.



↳ Problems in Engg & Managerial Economy originate in real world of Economic planning, management and Control.

↳ problem is defined & clarified by data from real world

↳ This Information is Subjected to analysis based on Scientific principles to formulate hypothesis in Symbolic terms.

↳ By Manipulating & Experimenting, an Analyst Can Simulate & project Reality in Multiple Configurations to understand outcomes. CAD Softwares Can alter product design in many ways.

Intrest and Time Value of Money (TVM)

Cost of money is determined by an Intrest Rate
Time value of money is defined as a time-dependent value of money stemming both from Changes in the purchasing power of money (Inflation / deflation) and from earning potential of Alternative Investment.

The Money available at the present time is worth more than the same amount in the future due to its potential earning capacity. The present money or provided money can earn Intrest. TVM is refered as present discounted value.

Eg: If Rs 100/- is Invested at Rs 10% of Intrest/per annum.

$F = P(1+i)^n$

By the End of year 1 $\longrightarrow$ F = 110/-
2 $\longrightarrow$ F = 121/-
⋮
10 $\longrightarrow$ F = 2597/-

If the Intrest Compounded many times in an year

$$F = P\left(1 + \frac{i}{n}\right)^{n \times t}$$

F → future value of money
P → present value of money
i → Intrest Rate.
n → no of Compounded periods / year
t → no of years

TVM depends on the Intrest Rate
Lower the Intrest Rate → lower value of money.
Higher Intrest Rate → Higher value of money.

Importance of TVM

→ A Rupee Recived now is not Comparable with the Rupee Recived in futur however they can be made Comparable by using Interest factor

→ The Concept of Considering Interst factor in the theory of finance is called Time-value of money.

→ Eg: If a fixed assest is purchased it requires Immediate Cash outflow but Cash inflow will generate over a period of time.

If a Cash is borrowed from a bank Cash is Recived Immediately but it has to be Repaid over a period of time by Considering the "Rate of Interest".

→ This Cashinflows & outflows over a period of time are not Comparable, ∴ Introduction of 'Rate of intrest' will allow us to adjust the value of cash Inflows & outflows to a perticular point of view. in terms of time.

→ Most financial decisions personal as well as business Involves TVM Considerations & their objective is to maximise share holders wealth.

It Can be done by

a) Compounding present Money to future date

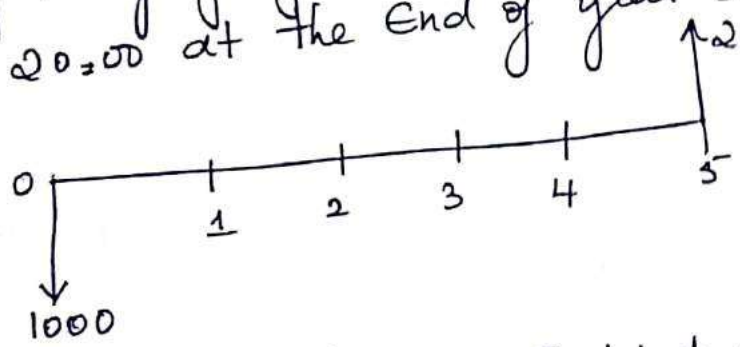
b) discounting future Money by present date.

Cash - flow Diagrams

It is difficult to solve a problem if you cannot see it. The easiest way to approach problems in Economic analysis is to draw a picture. The picture show three things.

1) A time Interval divided in to a appropriate ns of equal periods.
2) All cash outflows (deposits, Expenditures etc) in each period.
3) All cash Inflows (withdrawals, Income etc) for each period.

The below fig. shows a cash flow diagram showing an outflow or disbursement of Rs 1000 at the beginning of year 1 & an Inflow or return of Rs. 2000 at the End of year 5.



Notation to Simplify the Subject of Economic analysis, Symbols are Introduced to Represent types of Cash flows & Interest factor.

Concept of Simple and Compound Intrest

Intrest is the money paid for the use of borrowed money or the return on Invested Capital.

Rate of Intrest : It is Equal to the Intrest amount paid or ₹ recived over a period divided by principal sum borroued or lent (usually Expreed as %).

Simple Intrest

Simple Interest is Interest that is Computed only on the Original Sum.

If a loan of Present Sum of money P to some one at a simple annual Intrest raile 'i' for a period of n years, the amount of Intrest would be recive from the loan be ...

Total Interest earned = P × i × N

Total Amount of Money due at the End of loan be

$$F = P(1 + i.n)$$

where P → present Sum of money
F → Future Sum of Money
n → NO of Intrest periods
i → Intrest raile per period (%)

Compound Intrest is Calculated on the principal amount and also on the accumulated Interest of previous periods and thus can be stated as "Intrest on Intrest".

formula of Comp Intrest = $P[(1+i)^n - 1]$.

Co. Intrest formula for normal principal Amount is

* Single payment series

$$F(n) = P(1+i)^n$$

Where P = present Sum of Money. (Rs)
F = future Sum of Money
n = no of intrest periods
i = intrest Rate per period (%)

Generally, In Simple Intrest, the amount earned for Invested money or due for borrowed money in one period doesnot affect the principal for Intrest Calculations in later periods. However, this is not how Intrest is normally Calculated. In practice intrest is Computed using the Compound Intrest M. for a loan, any Intrest owned but not paid at the End of the year is added to the balance cost. Thus the next year's Intrest is Calculated based on the unpaid balance due., which Includes the unpaid Intrest from the preceding period. In this way, CI Can be thought as Intrest on top of Intrest. This way Compound Intrest distinguishes from Simple Intrest.

Interest Formulas

While making Investments decisions, Computations will be done in many ways. To Simplify all these Computations, it is Extremely Important to know how to use Interest formulas for Investment more Effectively. Before discussing the effective application of the Interest formulas for Investment-decision making, the various Interest formulas are presented first. Interest rate Can be classified into Simple Interest rate & Compound Interest Rate. In Simple 'intrest, the Interest is Calculated based on the Initial deposit for every Interest period.

In Compound Intrest, the Intrest for the Current period is Computed based on the amount at the beginning of the Current period.

TYPES.

① Single payment series.	② Equal payment series (Uniform series or)	③ Uniform gradient series

a) S.P → Compound Amount

$$F = P(1+i)^n$$

$$F = P\left[SP \rightarrow CAF\right]_n^i$$

b) SP → Present worth factor

$$P = F\left[\frac{1}{(1+i)^n}\right]$$

$$P = F\left[SP \rightarrow PWF\right]_n^i$$

a) EP → Comp. amount

$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$F = A\left[US \rightarrow CAF\right]_n^i$$

b) EP/US → Sinking fund factor

$$A = F\left[\frac{i}{(1+i)^n - 1}\right]$$

$$A = F\left[US \rightarrow SFF\right]_n^i$$

c) EP/US → PWF

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] \rightarrow P = A\left[US \rightarrow PWF\right]_n^i$$

d) US → CRF → capital Recovery factor

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right] \rightarrow A = P\left[US \rightarrow CRF\right]_n^i$$

a) UGS → PWF

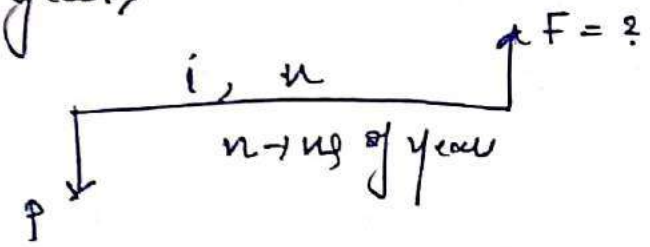
$$\bar{A} = G\left[\frac{i\left[(1+i)^n - in - 1\right]}{\left((1+i)^n - 1\right)i^2}\right]$$

$$F = G\left[\frac{i(1+i)^n - in - 1}{i^2}\right]$$

1 Single payment series.

Let, P = Sum invested today
F = Future Amount.
i = % age of intrest
n = no of years

Single payment



$$F = P(1+i)^n$$

End of year
$0 \rightarrow F = P$
$1 \rightarrow F_1 = P + Pi = P(1+i)$
$2 \rightarrow F_2 = P + Pi + P(1+i)i = P(1+i)^2$
⋮
$n \rightarrow F_n = P(1+i)^n$

$$F = P(SP \rightarrow CAF)_n^i$$

where SP = Single payment.

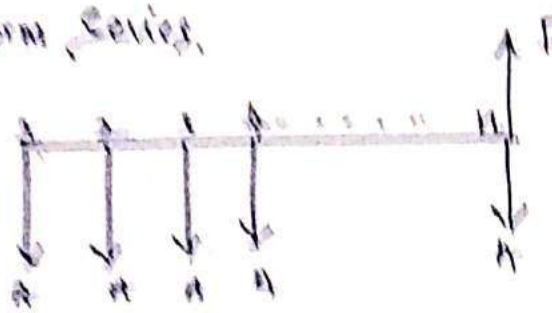
$$P = F\left[\frac{1}{(1+i)^n}\right]$$

$$P = F\,[SP \rightarrow PWF]_n^i$$

where CAF = Compound Amount factor
PWF = Present Worth factor.

2) Equal payment Series / Uniform Series

Uniform Series.



F = Future Amount
P = Sum Invested today
n = No of years
A = Annual payment or Annuity.

Suppose there is a payment situation where in an amount 'A' is deposited every year @ the end of each year for 'n' no of years. The future amount can be arrived Mathematically as follows

Eoy

$1 \longrightarrow F_1 = A$

$2 \longrightarrow F_2 = (A + Ai) + A = A[1 + 1 + i]$

$3 \longrightarrow F_3 = A[1+1+i](1+i) + A = A[1 + (1+i) + (1+i)^2]$

$\vdots$

$n \longrightarrow F_n = A[1 + (1+i) + \cdots + (1+i)^{n-1}]$

$$F = A(1+i)^{n-1} + A(1+i)^{n-2} + \cdots + A \longrightarrow (1)$$

x by Both sides by $(1+i)$

$$F(1+i) = A(1+i)^n + A(1+i)^{n-1} \cdots + A(1+i) \longrightarrow (2)$$

Sub (2) from (1)

$$F(1+i) - F = A(1+i)^n - A$$

$$F + Fi - F = A(1+i)^n - A$$

$$F = \frac{A[(1+i)^n - 1]}{i}$$

US → Uniform series
CAF → Compound Amount factor.

$$\boxed{F = A\left[\frac{(1+i)^n - 1}{i}\right] \Longrightarrow F = A[US \rightarrow CAF]_n^i}$$

$F = A\left[\frac{(1+i)^n - 1}{i}\right] \rightarrow F = A\left[US \rightarrow CAF\right]_n^i$ — (3)

$A = F\left[\frac{i}{(1+i)^n - 1}\right] \rightarrow A = F\left[US \rightarrow SFF\right]_n^i$ — (2)

SFF - Sinking fund factor

From Eq^n (2), Sub $F = P(1+i)^n$

$P(1+i)^n = A\left[\frac{(1+i)^n - 1}{i}\right]$

$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] \rightarrow P = A\left[US - PWF\right]_n^i$ — (c)

$A = P\left[\frac{(1+i)^n i}{(1+i)^n - 1}\right] \rightarrow A = P\left[US \rightarrow CRF\right]_n^i$ — (d)

where PWF = present worth factor
CRF = Capital recovery factor.

Note

Single Payment

$F = P(1+i)^n \qquad F = P\left(\text{-}P \rightarrow CAF\right)_n^i$

$P = F\left[\frac{1}{(1+i)^n}\right] \qquad P = F\left(\text{-}P \rightarrow PWF\right)_n^i$

Equal Payment of Uniform Series

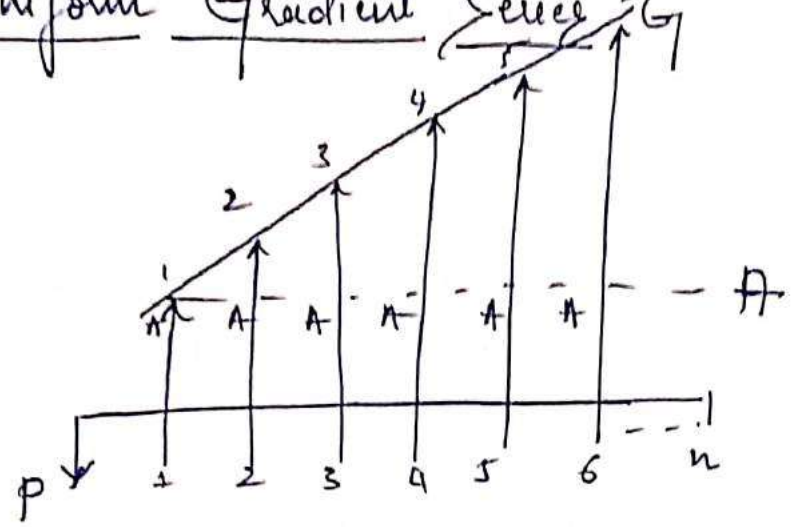
$F = A\left[\frac{(1+i)^n - 1}{i}\right] \qquad F = A\left(US \rightarrow CAF\right)_n^i$

$A = F\left[\frac{i}{(1+i)^n - 1}\right] \qquad A = F\left(US \rightarrow SFF\right)_n^i$

$P = A\left[\frac{(1+i)^n - 1}{(1+i)^n i}\right] \qquad P = A\left(US \rightarrow PWF\right)_n^i$

$A = P\left[\frac{(1+i)^n i}{(1+i)^n - 1}\right] \qquad A = P\left(US \rightarrow CRF\right)_n^i$

(3) Uniform Gradient Series

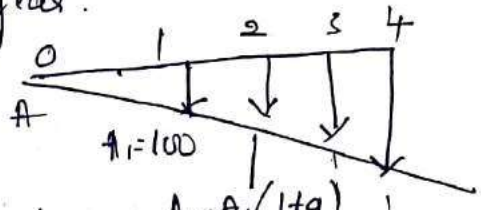


In Uniform Gradient Series, the annuity of payments or Reciepts Increases gradually make a slope line that is also known as Variable annuity.

$$P' = \left[A' + G\,(UGS)_i^n\right] \times (Us \to Pwf)_i^n \times (SP \to Pwf)_i^n$$

Insted of Constant amount of Increase, Sometimes cash flow increases by a uniform Rate of Increase every Subsequent period.

Eg: If the maintence cost of Car is 100/- for first year and Increasing by a uniform Rate of Increasing measure at a Rate of 10%/year.



$$A_n = A_1 (1+g)^{n-1}$$

$$P = G\left[\frac{(1+i)^n - in - 1}{(1+i)^n i^2}\right] = G\,[GPWF]_n^i$$

$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$A = G\left[\frac{i(1+i)^n - in - 1)}{[(1+i)^n - 1)\,i^2}\right]$$

$$A_3 = A_2(1+g)$$

$$A_4 = A_3 (1+g)$$

$$A_n = A_1 (1+g)^{n-1}$$

or

$$A_n = A_{n-1}(1+g).$$

(12)

Nominal and Effective Intrest Rates

Nominal Rate of Intrest: Generally, intrest rates are calculated on annual basis. If Compounding is done several times in a year say, - half, yearly, quarterly or monthly then the intrest rate quoted on an annual basis is called nominal intrest rate.

Eg: If one year is divided into 4 Quarters & each Quarter is Charged with an Interest rate of 2%, then the Interest is stated as 8% compounded ~~Quarterly~~ Annually. This Interest Rate is known as nominal intrest rate.

Problem: The future worth of Rs. 2000/- at the End of one year with Interest rate 8%. Compounded Quarterly.

Case (i): for Quarterly

$n = 4$ for Quarters

& $i = 2\%$ ie $\frac{8}{4}$ quarterly

$\therefore$ for Quarterly $n = 4$

$$F = P(1+i)^n = 2000(1+0.02)^4 = 2164 \text{ Rs}$$

Case (2) Compounded Annually

$n = 1$ for $i = 8\%$

$$F = P(1+i)^n = 2000(1+0.08)^1 = 2160 \text{ Rs.}$$

Hence nominal Intrest rate give higher returns.

Effective Intrest Rate

It is the actual Rate that applies for a stated period of time. Effective Interest Rates is used to describe Rate used to Calculate Interest Expense or income. Let it be the nominal Interest Rate Compounded annually, but in practice, the Compounding may occour less than a year. for Eg, Compounding may be monthly, Quaterly, or Semi-anually. Compounding monthly means the Intrest is Computed at the End of every month. for this 12 intrest periods in a year if the Intrest is Compounded monthly. Under such Situations, the formula to Compute the Effective Intrest Rate, which is Compounded annully for an Effective Interest Rate.

formula $i_{eff} = \left(1 + \frac{r}{m}\right)^m - 1$ or $\left(1 + \frac{r}{n}\right)^n - 1$

i = the nominal Intrest Rate

m = the no of Intrest periods in a year.
of Compounding periods / year.

Eg: For an Intrest Rate of 1.2 % / month. determine the nominal & Effective rates.
a) per quarter b) per year.

⟹ Nominal.

Effective
↳

Per quarter : $F = P(1+i)^n$

↓ Rate : $(1.2)(3) = 3.6\ \%/\text{qtr}$.

Per/year $(1 + 0.036)^3 - 1$

Per year = $1.2 \times 12 = 14.4\ \%$ / year.

Effective Rate / qtr $= \left(1 + \frac{r}{m}\right)^m - 1$

$= \left(1 + \frac{0.036}{3}\right)^3 - 1$

$= 3.64\% / qtr.$

Eff. Rate / year $= \left(1 + \frac{0.144}{12}\right)^{12} - 1$

$= 15.39\%$ per year.

② Determine the Effective Intrest Rate for a nominal Rate of 8% that is Compounded

i) Daily ii) Monthly iii) Quarterly iv) Semi-Annually

⟹ Given data $r = 8\%$

$i_{eff} = \left(1 + \frac{r}{m}\right)^m - 1$

i) Daily → $m = 365$ days Assuming not a leap year.

$i_{eff} = \left[1 + \frac{0.08}{365}\right]^{365} - 1 = 0.0832 = 8.32\%$

ii) Monthly $m = 12$

$i_{eff} = \left[1 + \frac{0.08}{12}\right]^{12} - 1 = 0.0829 = 8.29\%$

iii) Quarterly $m = 4$

$i_{eff} = \left(1 + \frac{0.08}{4}\right)^4 - 1 = 0.0824 = 8.24\%$

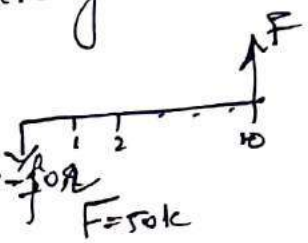
iv) Semi annully $m = 2$

$i_{eff} = \left(1 + \frac{0.08}{2}\right)^2 - 1 = 0.0816 = 8.16\%$

Problems

use formulas or Cash flow factor table for Soln.

(1) Mr. X wishes to have a future sum of Rs 50 lacks for his daughters tution fee for 10 years from now. what is the Single payment that he should deposit now so that he gets the desired amount after 10 years? The bank gives 12 % rate of intrest Compounded annually?



$\Longrightarrow$ F = 50,00,000 /-

i = 12 /-

n = 10 Y

P = ?

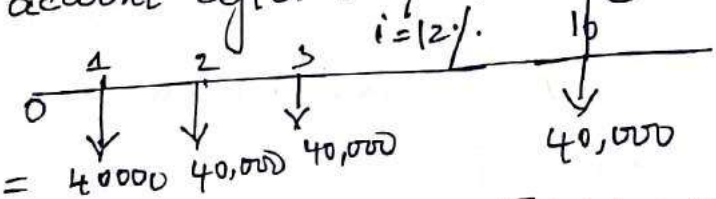
$$P = \frac{F}{(1+i)^n}$$

$$= \frac{50,00,000}{(1+0.12)^{10}}$$

$$P = 1609866.188$$

Sum of 16,09,866.188 Rs has to be deposited now to realize 50 lackhs ten year from now at i=12/.

(2) A man is planning to build his own house. He plans to divert his bonus of Rs 40,000-/- as Investment every year for next 10 years. The bank gives 12/. int. rate Compounded annually. find the maturity value of his account after 10 years.



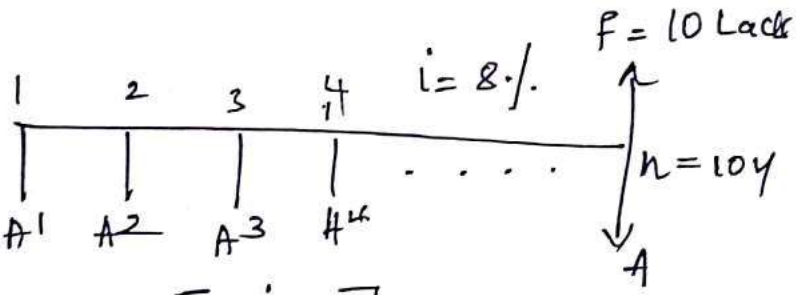
$\Longrightarrow$ A = 40000 40,000 40,000 40,000

$$F = A\left[\frac{(1+i)^n - 1}{i}\right] = 40,000\left[\frac{(1+0.12)^{10} - 1}{0.12}\right]$$

F = Rs 7,01,949 /-

(3) A person Estimates an Expenditure of Rs 10 L for her daughter's medical College from now. He plans to deposit an Equal amount at the End every year for next 10 years at $i = 8\%$. Comp. Annu. Find the Equivalent amount that must be deposited at the End of every year for next 8 years.

$\Longrightarrow$ F = 10 Lacks $N = 10y$ $i = 8\%$ $A = ?$.



$$A = F\left[\frac{i}{(1+i)^n - 1}\right] =$$

$$= 10,00,000 \times \left[\frac{0.8}{(1+0.8)^{10} - 1}\right]$$

$A = 2,246.89$ -/Rs. Annually for 10 years.

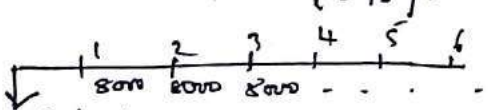
(4) A Certain piece of Equipment in a Computer Cf saves Rs 8000 per year in material 6 years. If a Sale Orgn has to earn 18% late Return, how much it Could be Justified now for the purchase of piece of Eqpt?

$\Longrightarrow$ $A = 8000$ $n = 6y$, $i = 18\%$, $P = ?$

$$P = \frac{8000}{A}\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

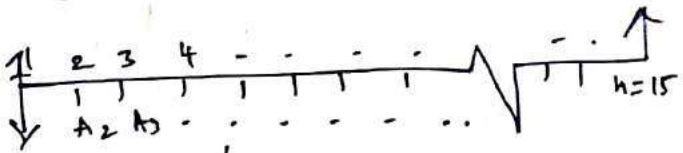
$$= 8000\left[\frac{(1+0.18)^6 - 1}{0.18(1+0.18)^6}\right]$$

$P = 27,980.8$



(5) If Rs 28,500/- is deposited into a saving account that earns 14% per year, what uniform annual amount could be withdrawn at the end of each year for 15 Y, so that nothing would be left in the account after 15th withdrawal

$\Longrightarrow$ A = ? , P = 28,500/- i = 14% , n = 15 Y



P = 28,500/-

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

$$= 28,500\left[\frac{0.14(1+0.14)^{15}}{(1+0.14)^{15}-1}\right]$$

A = 4639.8 Rs Annually → uniform annual Amount.

(6) Suppose a person Investing Rs 75000/- every year in a recurring deposit for 8 years. What is the amount we can expect to recive if intrest is 10%

$$\longrightarrow F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 75000\left[\frac{(1+0.1)^8 - 1}{0.1}\right] = 857691 \text{ Rs/-}$$

To find present value for present value

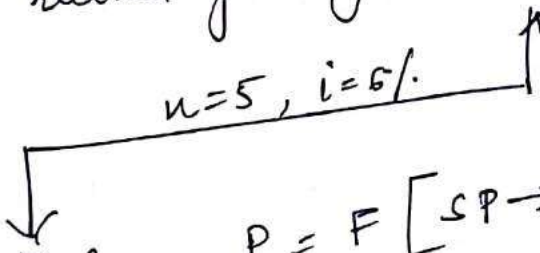
$$P = F\left[\frac{1}{(1+i)^n}\right] = 400119 \text{ /-} \longrightarrow$$

@ i = 3% $P = 857691\left[\frac{1}{1+0.03)^8}\right]$

$= 677069$ /- → After 8 year of 3% Int.

For next problems → by factor table - CFT

(7) What is the present worth of Rs 25,00,000-/- to be received of 5 years if the interest rate of 6%.

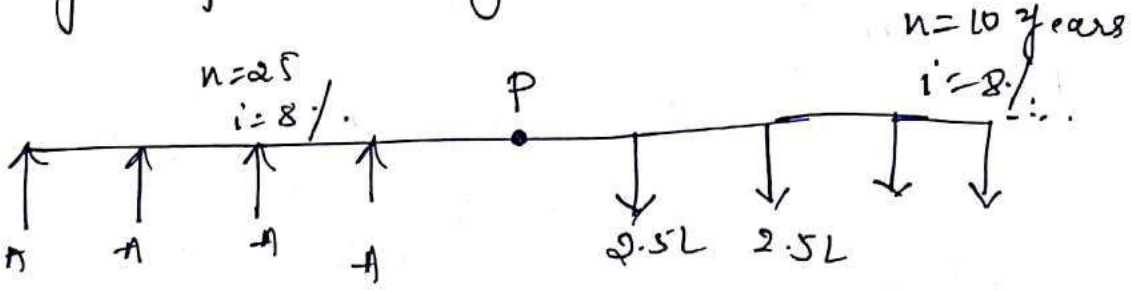


$P = F\left[SP \rightarrow PWF\right]^{5}_{6\%}$ → CFT – factor directly & solve by formulas

$P = 25,00,000\,[0.7473]$

$P = 1868250$ /-

(8) What amount a person should invest every year in order to get 250000-/- every year after 25 years for next 10 years. Take interest rate 8%.



Uniform Series.

$P = 250000\left[US - PWF\right]^{10}_{8\%}$

$= 2500000\,(6.7101)$

$P = 1677525$ /-

Present Amount i,e Invested amount after 25 years payment

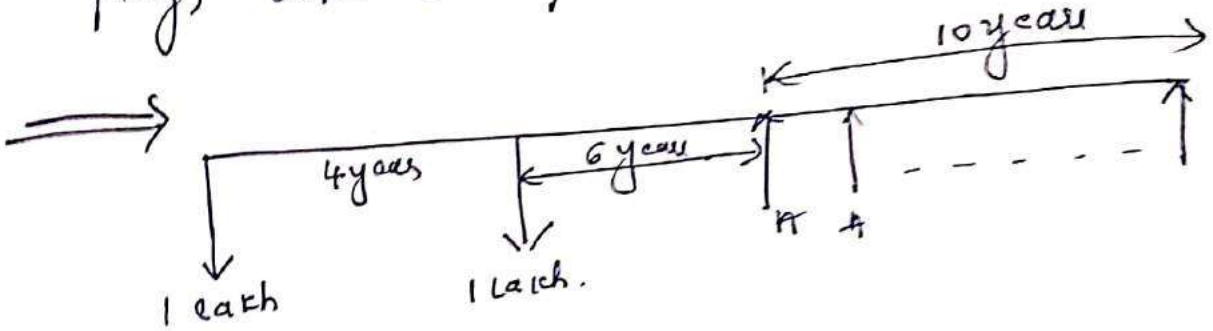
Then what annual amount is to pay for 25Y to recive 2.5L every ~~month~~ year for the P-1677525

$A = 1677525\left(US \rightarrow SFF\right]^{25}_{8\%}$

$= 1677525 \times 0.0137$

$\boxed{A = 22,989}$

④ A person borrows Rs. 1 lakh from bank to start an Enterprise. for the first 4 years he doesnot repay the loan. But at the end of 4 years he obtains a further loan of Rs 1 lakh from bank. At the end of further period of 6 years he starts Repayment of both loans & Clear them in a further period of 10 years. Calculate yearly instalment that he has to pay, take $i = 8\%$.



① $F_1 = P\,(SP \to CAF)^{4}_{8\%} + 1\,L$

$= 100000\,(1.36) + 100000$

$= 236000$ ⟶ present Amount @ 4 years

② $F_2 = P\,(SP \to CAF)^{6}_{8\%}$

$= 236000\,(1.587)$

$= 374532$ Rs/-

③ $A = P\,(US \to CRF)^{10}_{8\%}$

$= 374532\,(0.1490)$

$= 55805$ Rs/-

Comparision of Alternatives / IA Incremental Analysis (01)

Arpitha.D.J
1VI13CCT04.

List the different Methods of Comparison of alternatives & briefly discuss the need for decision criterion to choose the best alternative.

In Any Investment Involvement there will be few alternatives available & the Company will have to choose one from out of them. In such cases different alternatives must be Compared Methods of Comparision have been developed to Compare these alternatives & select the best one. Before making Comparision the Important Expendit Involved & the Salvage value associated with each altesnative should be clearly estimated.

Diff Methods of Comparision.

1) Present worth Method
2) Rate of return Method
3) Equivalent annual Method.

I) P.W.M : In this method all the items of net Cash flows are brought to the present value & the present value is Calculated at the beginig of year 1. This Method is also known as NPV (Net present value) method or discount cash flow method. Project with ⊕ve NPV Value will be accepted & when 2 proj has ⊕ NPV the project with greater NPV will be Chosen.

II Rate of Return Method

In this method the Internal rate of ret is calculated for various projects. The IRR a project is that rate of return @ which the NPV is Equal to zero.

III Equivalent annual Method.

This method is similar to net present v method but insted of determining a single number occuring at the begining of the ye it is possible to Compare projets by determing ohother numbes which occurs repeatedly at the End of each yeas from the begining period.

1) ~~ROR~~ P.W.M

1st step: PWM $(Alt_1 - Alt_0)$ → If ⊕ve. Alt_1 is best
↓ do nothing

PWM $(Alt_2 - Alt_1)$ → If ⊕ve Alt_1 is best

PWM $(Alt_3 - Alt_1)$ → If ⊕ve, Alt_3 is bost

$$PWM = -IC + NAI\left[US - PWF\right]^{i\%}_{n}$$

2) R.O.R

$[Alt_1 - Alt_0]$ $\quad 0 = -IC + NAI\left[US - PWF\right]^{i\%}_{n}$

for i → Intefolate, take values in chart.

If i is Greater than Given i → Curret bost is Chosen

3) EAM

$$EAM[Alt_1 - Alt_0] = -IC\left[US - CRF\right]^{i\%}_{n} + NAI$$

Procedure

1) The alternatives should be listed in the assending order of their first cost.
2) The Method adopts an Intial Current best alternative. In most cases their will be do nothing alternatives.
3) Cash flow tables are prepared on an Incremental basis b/n the alternatives which is being Examine & current best alternative is choosen.
4) Analysis proceds from the least Initial Alternatives to the next Initial Cost of highes one.
5) When an alternative which has just as been examine, it becomecs Current best replacing the Earlier one.
6) The analysis can be terminated at any level of Investment, if there is a limit or avilablity of funds.

2008-10M

1) The cash flow of three alternatives are shown below. The Interest rate is 15 percent. Choose the best alternative among the three using Incremental analysis.

Eoy	Alt-1	Alt-2	Alt-3
0	-50,000	-80,000	-1,00,000
1	+14,000	+19,000	+25,000
2	+14,000	+19,000	25,000
3			
4			
5			
6			
7			
8			
9			
10	+14,000	+19,000	+25,000

By Present Worth Method.

Eoy	do-nothing Alt-0	Alt-1
0	0	-50,000
1-10.	0	+14,000

10 yrs $i = 15\%$.

$$PWM[Alt_1 - Alt_0] = -50,000 + 14,000\,[US - PWF]_{10}^{15\%}$$

$$= -50,000 + 14000\,(5.0188)$$

$$= 20\,263.2 \text{ Rs.}$$

Alt 1 is best

$$PWM[Alt_2 - Alt_1] = -(80,000 - 50,000) + (19000 - 14000)[USPWF]_{10}^{15\%}$$

$$= -30,000 + 5000\,(5.0188)$$

$$= -4906 \text{ Rs}$$

Alt 1 is best.

$$PWM[Alt_3 - Alt_1] = -[1,00,000 - 50,000] + [25000 - 14,000 \times [US - PWF]^{}_{12}$$

$$= -50\,000 + 11000\,(5.0188)$$

$$= 5206.8 \text{ Rs}$$

Alt 3 is best.

By present worth Method of Incremental Analyeis Alt-3 is best among three.

.. By Annual Equalent Method.

$$AEM[Alt_1 - Alt_0] = -50,000[US - CRF]^{15\%}_{10} + 14\,000$$

$$= -50,000\,(0.1993) + 14000$$

$$= 4035 \text{ Rs}$$

Alt_1 is best.

$$AEM[Alt_2 - Alt_1] = -30,000[0.1993] + 5000$$

$$= -979 \text{ Rs}$$

Alt_1 is best.

$$ACM[Alt_3 - Alt_1] = -50,000[0.1993] + 11000$$

$$= 1035. \text{ Rs}$$

Alt_3 is best.

By AEM of Incremental Analyeis Alt-3 is best among three.

By Rate of Return Method.

$$ROR\,[Alt_2 - Alt_0] = -50{,}000 + 14{,}000\,[US\text{-}PWF]^{i=?}_{10}$$

Equate for 0.

$$P = A\left[\frac{(1+i)^n - 1}{(1+i)^n i}\right]$$

formula.

$$0 = -50{,}000 + 14{,}000\,[US\text{-}PWF]^{i=?}_{10}$$

$$3.571 = [US\text{-}PWF]^{i=?}_{10}$$

$i = 25\%$ from table A-25. Int. factor table.

$i = 25\% > 15\%$ i.e. $15\% < 25\%$

Alt 1 is Current best.

$$ROR\,[Alt_2 - Alt_1] = -30{,}000 + 5000\,[US\text{-}PWF]^{i=?}_{10}$$

$$6 = [US\text{-}PWF]^{i=?}_{10}$$

$i = 10.6\% < 15\%$.

$i = 6.1446$ @ 10%

$i = 5.8892$ @ 11%.

By interpolation

So Alt 1 is best.

$$ROR\,[Alt_3 - Alt_1] = -50{,}000 + 11000\,[US\text{-}PWF]^{i=?}_{10}$$

$$4.54 = [US\text{-}PWF]^{i=?}_{10}$$

$17.9\% \approx 18\% > 15\%$

Alt 3 is best.

By Conclusion Alt:3 is best by RoR Method.

Minimum Cost Analysis (or) R.A
Replacement analysis.

Arpitha.D.J
1V513CCT04

Discuss breyfy the Importence of Rep. Analyeis.

In business & Companies Some Suitvations Exists where we have to Consider replacing an Existing plant or mechicne with a new one. This situation may arise because of few resons.

1) Damage to the Mechin
2) Increse in maintainance & operation cost leading to uneconomical use
3) Inadequacy of plant & M/c & therefore to Increee the Capacity of production
4) Technological obsolescence.

The replacement of Exisisting plant or mechine will always be with a new one & hence R.A involves Compaision of Existing mechine with a newone. A new mechine or plant is refleed to as 'CHALLENGR" & the Existing asset is called DEFENDR.

Y Replacement is needed
Mainly due to 3 types
- obsolesence
- New requiremenil / Inadequacy
- Deterioration.

Define

1) Sunk cost. If the existing asset has been pu... at a cost of 'm' some years ago, its valu... generally reduces over a period of time & toda... its worth is say 'n' then the diff b/n m & n will be the Sunk cost. SC = (m-n) is not consid... in the replacement analysis.

2) Salvage Value. When an assest is disposed of at the end of useful or economic life... its worth something still may be as a scrap. The value which will be obtained at the End of life of the assest is termed as salvage value.

S.V ≠ n where n is todays tradable value.

3) Trade in Value. This is the value of the assest if it is sold or Exchaned today. Tinv is fixed by a third party if they are willing to buy this assest.

4) Third party Concept. In accounting transactions Selling or buying will influence companies decisions but decisions have to be uniformly accepted & hence they have to be made with 3rd party Concept. In this Concept if a Third party buys the existing machine, it will be decided the trade-in-value & treated as a receipt (Cash i/f). For the purpose of replacement analysis even with 3rd party Concept the trade-in-value has to be treated as Intial cost made.

An Assent which was purchased for 2,00,000 ₹-, 4 yrs ago is being Considered replacement agnst a challenger whose cost is 2,40,000 ₹-. The trade in value of the Existing asset & its salvage value after 6 years from now are Rs 60,000 ₹- & Rs 20,000 respectively. It has an AM&O Cost ₹0,000 ₹. The new machine has a S.V of 30,000 ₹- at the End of its 10 yrs Expected life of yrs. & O M&A - 35,000 ₹. If MARR 15 ₹-. should the Existing Eq. be replaced?

Defender: Ic of D: 2,00,000 — 1 yr ago purchased
T in value - Rs 60,000, salvale = Rs 20,000
O&M - ₹0,000 for 6 yrs

$$AE_{Dg} = -60,000\underset{0.2642}{[US-CRF]_6^{15\%}} + 20,000\underset{0.1142}{[US-SFF]_6^{15}} - 70000$$

$$= Rs - 83,568 \text{ ₹-}$$

Challenger: Ic: Rs 240,000
O&M - ₹5,000 Rs
SV - Rs 30,000 @ 10 yr life span

$$AE_{challe} = -240,000\underset{0.1993}{[US-CRF]_{10}^{15\%}} + 30,000\underset{0.0493}{[US-SFF]_{10}^{15\%}} - 35,000$$

$$= Rs - 81,353 \text{ ₹-}$$

Since the annual Cost of Challenger is less i.e new machine Cost is less than the Defender/Exsist asset -- so the new machine is ad-opted

of Vessel replacing with new one. The present pressure vessel having an annual operation M, of 60,000 can be used for further 5 yrs. If it was sold now, its worth Rs 30,000. A new pressure vessels can be purchased for 1 lack Rs 1,20,000 & Market value after 5 years is 50 thousand & Dep = 30,000. MARK 20/. is the PV is Replaced or not?

Challenger old PV

5 yrs usage
O&M 60 000
Tinv 30,000

Defender : NPV

I cost 1,20,000 Rs
Tinv 50,000 Rs
A&M 30,000 Rs
5 yrs

$$NPV_{chal} = -30,000\left[\underset{0.3344}{US\text{-}CRF}\right]_5^{20\%} - 60,000$$

$$= -70,032 \text{ Rs}$$

$$NPV_{defender} = -1,20,000\left[\underset{0.3344}{US\text{-}CRF}\right]_5^{20\%} + 50,000\left[\underset{0.3344}{US\text{-}CRF}\right]_5^{20} - 30,000$$

$$= -53,402 \text{ Rs}$$

Replaced is necessary.

Machine brought 3 y ago for 1 lacs., 8 yrs life remaining. Annual operating cost Rs 23,000 S.V - Rs 10,000 [after 8 yrs], Sell exist M = 75,000 New Machine Rs 1,50,000, O&M 10,000/yr, life 8 yr No salv value, keep the old M or rep with new y MARR is 10%.

Challenger

IC = 1,50,000 Rs
O&M = 10,000/yr
Nosal - 8 yrs

Defender.

Tinv = 75,000
A&op = 23,000
SV 10,000
8 yrs

$$AE_D = -75,000 [CS-CRF]^{10\%}_{8} + 10,000 [US-SFF]^{10\%}_{8} - 23,000$$

0.1875 (CS-CRF) 0.0874 0.0875 (US-SFF)

$$= -36187.5 \text{ Rs}$$

$$AE_{challenger} = -150,000 [US-CRF]^{10\%}_{8} - 10,000.$$

0.1875

$$= -38,128.$$

Annuale of Challenger is more than Defender So no replacement.

4] A Quarry plants on new pit that will last for production, an existing dozer with 5 years of s remig can be used. The existing dozer, book va 50,000 & SV 5000 & OM of first year cost 10,0 which will Increase @ Rs 2000/year. A new doz can be purchased for Rs 1,00,000/- with a 10 y survive life O&M cost 1st yer 4000 with 500 Rs Increase per years. The estimate resell is Rs 40,000 at 5 years. should quarry by the new dozer is Rep @ 10%.

(3)

Def.

B.V = 50,000

SV = 5000

OM = 10000

Inin O&M 2000/years.

Challenger

EC - 1,00,000 - 10yrs

Tin v = 40,000 - 5yrs.

O&M - 40,000

Inc - 500/years

$$AE_D = -50,000\underset{0.2638}{[US-CRF]}_5^{10\%} + 5,000\underset{0.1638}{[US-SFF]}_5^{10\%} - 10000 + 2000\underset{1.8101}{[\text{Uniform gradient factor}]}$$

$$= -18750.8 \text{ Rs}$$

$$AE_{challenge} = -1,00,000\underset{0.1628}{[US-CRF]}_{10}^{10\%} + 40,000\underset{0.2638}{[US-CRF]}_5^{10\%} - 4000 + 500\underset{1.8101}{[UGS\ Fact]}_5^{10\%}$$

$$= -8822.95 \text{ Rs}$$

An Engineer has a Choice of Payment either type A or type B pavement. Type A has life years of 10 years, after which the pavement materials can be salvage & reuse. Type B pavement only last 5 years but it is less expensive. which is best option.

Particulars	A	B
Initial Cost	Rs 20000	Rs 5000.
Annual O&M	Rs 1000	Rs 2000
Life	10 yrs	5 yr.
Salvage value	Rs 2500	Rs. 0.

Type A

AE of IC = $20000[VS\text{-}CRF]_{10}^{10}$

= 20000 (0.1628)

= −3256

AE = −1000

AE = $2500\,[0.0628)^{SFF}$

= −157

AE = −4099

Option B is preferred.

Type. B

$AE = 5000\,[0.2638]_{5}^{10\%}$

= −1319

AE = −2000

AE = 0

AE = − 3319

For a project details of 2 Models are as follows

Particulars	Mod-I	Mod-II
Capital cost	10,00,000	8,00,000
Annual O & M	160000	200000
Life	8 Y	8 Y
Salvage Value	100000	80000

If the rate of Intrest is 8%, which is the superior.

I Annual Equivalent Method

Mod: I

(1) Annual Equivalent of capital cost

$A_1 = P[US \rightarrow CRF]^{8}_{8\%}$

$= 1000000 \times 0.1740$

$= -174000/-$

(2) $A_2 = -1,6,0000/-$

(3) $A_3 = F[US \rightarrow SFF]^{8}_{8\%}$ (Salv. Annual value)

$= 100000 \times 0.0940$

$= 9400/-$

Mod - II

(1) AE of CC

$A_1 = P[US \rightarrow CRF]^{8}_{8\%}$

$= 800000[0.1740]$

$= -139200/-$

(2) $A_2 = -200000$

(3) $A_3 = 80000[0.094]$

$= 7520/-$

EAE of M-I $= -324600/-$ EAE of M-II $= -331680/-$

By present worth Method

Mod-I

(1) PWC (−)

$P_1 = -1000000$ /-

(2) PW of O&M (−)

$P_2 = A\left[US \rightarrow PWF\right]^{8}_{8\%}$

$= 160000 \times 5.7466$

$= -919456$ /-

(3) SV → present worth (+)

$P_3 = F\left(SP \rightarrow PWF\right]^{8}_{8\%}$

$= 100000 \times 0.5403$

$= 54030$ /-

M-I $\Sigma PW = -1865426$

Mod-II

(1) PW of Capital Cost

$P_1 = -800000$

(2) PW of O&M

$P_2 = 200000\left[5.7466\right]$

$= -1149200$ /-

(3) PW of salv

$P_3 = 8000\left[0.5403\right]$

$= 43224$

M-II $\Sigma PW = -1906096$

I Based on Annual Equivalent, Mod-I has lower Expenditure than mod-2, hence Model-1 is prefered over Model-2.

Note: whenever useful life is unequal always do by annual Eq. Method

II Based on Comparision the present worth of Model-I is lower than Mod-II, hence Mod-I is prefered.

Break Even Analysis.

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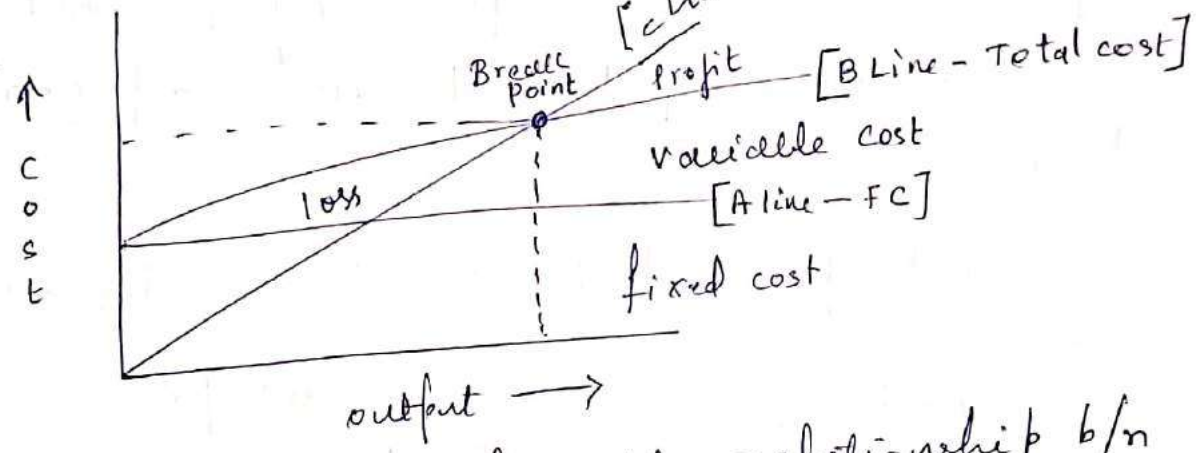
1VJ13CCT04

1) Break even Analysis is also called Equal Cost analysis or cost/volume/profit analysis.

2) It is a technique used for studying rel"ship among fixed cost, variable cost, sales volume and profits.

3) It can be explained through breakeven chart.

a)



b) Break even chart shows the relationship b/n total revenues, total operating costs & the profits for various levels of prod" & sales.

c) This analysis determines the pt. @ which the total revenue & total cost are Equal. Such a pt is called a break even point. The Intersection of Total cost line with total revenue line determines the break even pt.

"Break even point is defined as the sales volume required for total revenue to Equal total operating costs." It is Expressed in no of units. [B]

4) Break even Analysis determines the relationship among total costs, total revenue & profits, profit for diff volumes of production. This analysis helps the management to maximising profit and avoiding losses.

5) In BEA Costs & Revenue are Expressed as a function of produn rate. The cost revenue profit relations are exposed by breaking down a unit of output into its Component rupee value.

one-unit opt = $\underbrace{\text{Profit, variable cost, fixed cost}}_{\text{selling price.}}$

for prodn of one unit profit, variable cost & fixed cost is needed.

fixed cost : The cost that remain relatively constant regardless of level of activity.
— known as fixed cost / Indirect cost.

Variable cost The cost that are Generally proportional to output are called V.C / D.C.

6) B.E.A can be done in 2 Methods

a) Graphical Method → $\begin{cases} C_1 = f_1(x) \text{ — a fn of } x \\ C_2 = f_2(x) \text{ — fn of } x. \\ \quad \text{↳ Total cost, annual cost, cost per day} \end{cases}$

$C_1 = C_2$

$f_1(x) = f_2(x) \ldots$

To get value of x. → B.E. value.

b) Graphical Method.

Features of Break Even Curve.

1) It is an aid to the management, depicting a clear view of the position of business
2) The chart shows likely profits & losses at diff outputs
3) It represents the marginal costs with reference to the fixed cost.
4) It marks no profit no loss situation.
5) Margin of Safety is also shown
6) It helps to reduce expenses so that profits are increased.

8) Limitations of B.E. chart

1) Since Market Conditions fluctuate continuously it is difficult to determine the break even point. Moreover costs cannot be easily classified
2) It can be used for short term analysis i,e for short periods.
3) The Chart repents a static picture, whereas business operations are not static
4) The Analysis of cost becoms tough if the variety of products are prepared.
5) It gives only alternative approches or guideline to management

Formulas:

N → No of Units produced per period

B → Break even point.

Fd → Fixed cost

S → selling price

R → Total Revenues = N X S

V → Variable costs per Unit

M – Total profit

C – Total costs = $F_d + (N \times V)$

1) To find Break even pt.

Total revenue = Total costs

$R = C$

$N \cdot S = F_d + (N \times V)$ $\quad N = B.$

$N \times S = F_d + (B \times V)$

$BS = F_d + BV$

$BS - BV = F_d$

$$B = \frac{F_d}{S - V}$$

2) To find total profit.

Total profit = Total Revenue – Total costs

$M = R - C$

$M = NXS - F_d + (N.V)$

$= NS - F_d - N.V$

$M = N(S - V) - F_d.$

A Company is Engaging in fly ash brick which are sold at uniform price @ 4 Rs/unit variable cost is 2.5 Rs/unit & fixed cost 20,000 Rs. Find the no of units to be sold so that the Company is reached breakeven. further how much Sales has to be made @ this level of activity. if company decide a profit of 1 lack Rs.

Given: $S = 4$ Rs/unit

$V = 2.5$ Rs/unit

$Fd = 20,000$ Rs

$B = ?$ $N = ?$ for $M = 1,00,000$ Rs $N = ?$

$$B = \frac{Fd}{S - V} =$$

$$= \frac{20,000}{4 - 2.5}$$

$$= 13333.3$$

$$B. = 13334 \text{ Rs}$$

$$M = R - C$$

$$M = Ns - Fd + (N.V)$$

$$M = N(S - V) - Fd.$$

$$\frac{M + Fd}{S - V} = N$$

$$\frac{100000 + 20,000}{4 - 2.5} = N = 80,000 \text{ units}$$

A Company is Engaging in fly ash brick which are sold at uniform price @ 4 Rs/unit variable cost is 2.5 Rs/unit & fixed cost 20,000 Rs. Find the no of units to be sold so that the Company is reached breakeven. Further how much Sales has to be made @ this level of activity. If company decide a profit of 1 lack Rs.

Given: $S = 4$ Rs/unit

$V = 2.5$ Rs/unit

$Fd = 20,000$ Rs

$B = ?$ $N = ?$ for $M = 1,00,000$ Rs $N = ?$

$$B = \frac{Fd}{S - V} =$$

$$= \frac{20,000}{4 - 2.5}$$

$$= 13333.3$$

$$B = 13334 \text{ Rs}$$

$$M = R - C$$

$$M = NS - Fd + (N \cdot V)$$

$$M = N(S - V) - Fd.$$

$$\frac{M + Fd}{S - V} = N$$

$$\frac{100000 + 20,000}{4 - 2.5} = N = 80,000 \text{ units}$$

(2) A Company wants to purchase Existing RMC plant with good working condition. Capital Invest 5 crore Rs. OMC for prodn of Concrete is 3000 Rs/cubic mtr. The concrete sold at 4000 Rs/mtr cube. What annual Conc. volume must Company sale to Breadeven. if MARR is 15%. Assume 20 yrs plant life in salvage value of 10%.

⟹ (C) = Capital Invest = 5,00,00,000 Rs for 20 yrs @ 15%

(S) = 20 yrs plant life in salvage of 10%.

50,00,000 Rs @ End of 20 yrs @ 15%.

for $F_{d\,annual} = 5C\left[US\text{-}CRF\right]^{20\,yrs}_{15\%} - 50L\left[US\text{-}SRF\right]$

$= 5C[0.1598] - 50L[0.0098]$

$F_{d_A} = ₹\,9,41,000$

$B = \frac{F_d}{S-V} = \frac{₹\,9,41,000}{4000 - 3000}$

$= ₹\,941\ m^3/year.$

A Contracter is thinking of selling present dumper & buying new one. The new truck costs 8.5 lacks & 15 yrs expect life. OMC of Rs 6 per tonne-Mile. It has no salvage value. The present truck sold for 3.5 lack & if it is kept & it is cash as Rs 9/tone-mile. It has expected life of 5 yrs & No Sal. value. Take i = 10%. Find B.E.P in terms of Tonn-mile per year.

$\Longrightarrow$ $I_{C\,NT}$ = 8.5 L for 15 y @ 10%

$Fd_{an} = 8.5\,L\,[US\text{-}CRF]^{10\%}_{15}$

$= 850000\,[0.1315]$

$= 1,11,775$ RS.

Fd old truck $= 3.5\,L$

$= 3.5\,L\,[US\text{-}CRF]^{10\%}_{5}$

$= 3.5\,L\,[0.2638]$

$= 92330$ Rs

$B = \frac{Fd}{S - V}$ $\quad BS - BV = Fd.$

$BS = Fd + BV$

New.

$BS = Fd + BV$

$= 111775 + B(6)$ — (1)

old.

$BS = Fd + BV$

$= 92330 + B(9)$ — (2)

Eq^n (1) & (3)

$111775 + 6B = 92330 + 9B$

$B = 6481.6 \approx 6482$ Tonne-mile

$B = 6482$ T-m.

④ A Company is Engaged in producing pre... door frames which are sold at uniform price of 1800 each. The variable Cost is Rs 1200 per... & fixed Cost RS 270,000. How many units of door frames must be produced & Sold so that the Company can Break even? How much Sales would be made at this level of activity if the company desires a profit of Rs 500000?

$\Longrightarrow$ $S = 1800$ per unit

$V = 1200$ per unit

$F_d = 270,000$ Rs.

$$B = \frac{F_d}{S-V} = \frac{2,70,000}{1800-1200} = 450$$

$M = 5,00,000$ RS , $N = ?$.

$$N = \frac{M + f_d}{S-V}$$

$$= \frac{5\,00,000 + 2,70,000}{1800 - 1200}$$

$N = 1283.3$

$= 1284$ NOS. units.

The purchase of an existing RMC plant in good operating condition requires a capital investment of Rs 5,00,00,000. Cal. of O & M costs of producing Concrete are Rs 2600 per cub mete of concrete. If concrete is sold for Rs 3400 per cub what annual vol. of concrete must the comp sell at break even, if before tax MARR 20%. Assume a 20 yr life with an estimated salvage value of Rs 50,00,000.

CPI = 5,00,00,000 Rs for 20 yrs @ 20%.

Salv = 20 yrs of 50,00,000 Rs @ 20%.

$$\text{So } F_{dan} = 5,00,00,000\,[US\text{-}CRF]_{20}^{20\%} - 5000000\,[US\text{-}SFF]_{20}^{20\%}$$

$$= 5\,c\,[0.2054] - 50\,L\,[0.0054]$$

$$= 1,02,43,000 \text{ Rs}$$

$$B = \frac{Fd}{S-V} = \frac{1,02,43,000}{3400-2600} = 12803.75$$

$$B = 12804 \text{ m}^3/\text{year}.$$

⑥ A Contractor is thinking of selling his present truck & buying a new one. The new truck cost Rs 850000/-. It is expected to incur operating & maintence cost of Rs 2.5/ton-mile. It has a life of 15 y with no salvage value. The presently owned truck can be sold now & for 370000/- If keep it will cost 3.3/ton-mile. It has an expected life of years & no salv. value. Use Interest rate 10% & find BEP in ton-mile/yr.

$\Rightarrow$ I.C. N. truct 850000 for 15 yrs 10%.

$Fd_{N.T} = 850000 [US\text{-}CRF]^{10\%}_{15}$

$= 850000 [0.1315]$

$Fd_{N.T} = 111775$ Rs

$Fd_{old.T} = 370000 [US - CRF]^{10\%}_{5}$

$= 370000 [0.2638]$

$Fd_{NT} = 97606$ Rs

$B = \frac{Fd}{S - V}$ $\quad BS - BV = Fd$

$BS = fd + BV$

$B_{S_{N.T}} = 111775 + B(2.5)$ — ①

$B_{S_{O.T}} = 97606 + B(3.3)$ — ②

① = ② $\quad 111775 + 2.5B = 97606 + 3.3B$

$14169 = 0.8B$

$B = 17711.25$

$B = 17712$ ton-mils/year.

Time value of Money.

1) A Rupee received now is not comparable with the rupee received in future howeves they can be made comparable by using Interest factor.

2) The Concept of Considering Interest factor in the theory of finance is called T-V of money

3) Eg: If a fixed assect is purchased it requires immediate cash outflow. but cash inflow will geneate over a period of time.

Eg: If a cash is barrowed from a bank cash is received immediately but it has to be repaid over a period of time by considering "rate of Interest."

4) This Cash Inflows & outflows over a period of time are not comparable, ∴ introduc of "rate of interest" will allow us to adjust the value of cash Inflows & outflows to a perticular point in time.

5) Most financial decisions personal as well as busineu Involves time value of Money Consdrn.

6) The objective of Mgt should be to Maximise share holders' wealth

It can be done by

a) Compoundin Pres Money to a future date

b) discounting future Money by Present date.

Expression for sinking fund for equal payment series

Let us consider.

EOY	Accumulated Amount
1	$F_1 = A$
2	$F_2 = A + Ai + A = A(1+i) + A$ $= A[(1+i) + 1]$
3	$F_3 = A[(1+i)+1] + A[(1+i)+1]i + A$ $= A[(1+i)+1][1+i] + A$ $= A[(1+i)^2 + (1+i)] + A$ $= A[(1+i)^2 + (1+i) + 1]$
⋮	⋮
n.	$F_n = A[(1+i)^{n-1} + (1+i)^{n-2} \ldots + 1]$

$$\therefore F_n = A\left[(1+i)^{n-1} + (1+i)^{n-2} + \cdots + (1+i)^2 \cdots + 1\right] \quad -(a)$$

x by $(1+i)$ on both side

$$F_n(1+i) = A\left[(1+i)^n + (1+i)^{n-1} + \cdots + (1+i)^2 + (1+i)\right] \quad -(b)$$

$b - a \Longrightarrow A(1+i)^n + A(1+i)^{n-1} + \cdots A(1+i)^2 + A(1+i)$
$- A(1+i)^{n-1} - A(1+i)^{n-2} + \cdots - A(1+i)^2 - A$

$$F_n(1+i) - F_n = A(1+i)^n - A$$

$$(1+i-1)F_n = A[(1+i)^n - 1]$$

$$F_n = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$A = F\left[\frac{i}{(1+i)^n - 1}\right]$$

$$A = F\left[US - SFF\right]^i_n$$

22/2

Time value of Money :-

Interest formulae

A) Single Payment Series :-

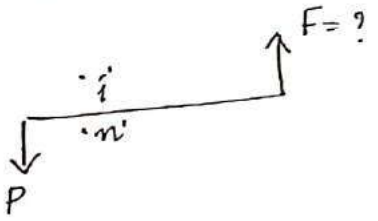
let P = Sum invested today

F = future Amount

i = % age of interest

n = no of years.

Single Payment :



$$F = P(1+i)^n$$

End of year (EOY) '0' = $F = P$

1 = $F_1 = P + Pi = P(1+i)$

2 = $F_2 = P + Pi + P(1+i)i = P(1+i)^2$

$n = F_n = P(1+i)^n$

$F = P(SP - CAF)^i_n$

where SP = Single Payment.

CAF = Compound Amount factor

$$P = F\left[\frac{1}{(1+i)^n}\right] \longrightarrow (2)$$

$$\therefore P = F\left[SP - PWF\right]^i_n$$

PWF = Present worth factor

B) Equal Payment Series [EPS]

Uniform Series [US]

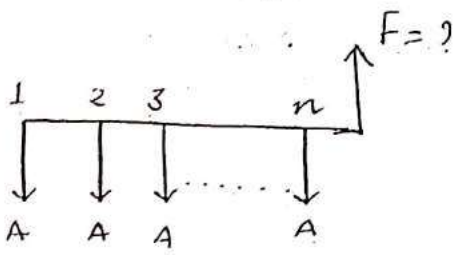
A = Annuity

P = Sum invested today.

F = % age of interest

n = no% of years

A = Annual payment.



Suppose there is a payment situation where in an amount 'A' is deposited every year @ the end of each year for 'n' no of years. The future amount can be arrived mathematically as follows.

E.O.Y.

1 $\longrightarrow F_1 = A$

2 $\longrightarrow F_2 = (A + Ai) + A = A[1 + 1 + i]$

3 $\longrightarrow F_3 = A[1 + 1 + i](1+i) + A = A[1 + (1+i) + (1+i)^2]$

n $\longrightarrow F_n = A[1 + (1+i) + \ldots + (1+i)^{n-1}]$

$\therefore F = A(1+i)^{n-1} + A(1+i)^{n-2} + \ldots + A \longrightarrow i$

x'ly B.S by $(1+i)$

$F(1+i) = A(1+i)^n + \ldots + A(1+i) \longrightarrow ii$

Subtract i from ii

$F(1+i) - F = A(1+i)^n - A$

$Fi = A(1+i)^n - A$

$$F = \frac{A[(1+i)^n - 1]}{i}$$

$F = A[US - CAF]^i_n$

US = Uniform series
= Equal Payment series

from eq^{n} ③

$$A = F\left[\frac{i}{(1+i)^n - 1}\right] \longrightarrow ④$$

$A = F(US - SFF)^{i}_{n}$ SFF = Sinking fund factor

from eq^{n} ③

$$P(1+i)^n = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$P = A\left[\frac{(1+i)^n - 1}{(1+i)^n \cdot i}\right] \longrightarrow ⑤$$

Rearranging eq^{n} ⑤

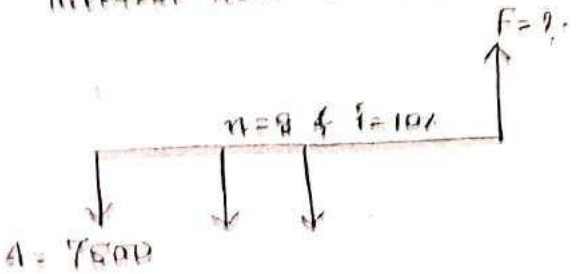
$$A = P\left[\frac{(1+i)^n \cdot i}{(1+i)^n - 1}\right] \longrightarrow ⑥$$

$A = P[US - CRF]^{i}_{n}$ CRF = Capital Recovery Factor.

1. Single Payment	$F = P(1+i)^n$	$F = P(SP - CAF)^{i}_{n}$
	$P = F\left[\frac{1}{(1+i)^n}\right]$	$P = F(SP - PWF)^{i}_{n}$
2. Equal Payment	$F = A\left[\frac{(1+i)^n - 1}{i}\right]$	$F = A(US - CAF)^{i}_{n}$
	$A = F\left[\frac{i}{(1+i)^n - 1}\right]$	$A = F(US - SFF)^{i}_{n}$
	$P = A\left[\frac{(1+i)^n - 1}{(1+i)^n \cdot i}\right]$	$P = A(US - PWF)^{i}_{n}$
	$A = P\left[\frac{(1+i)^n \cdot i}{(1+i)^n - 1}\right]$	$A = P(US - CRF)^{i}_{n}$

Problems:

1. A person is investing 7,500/- every year in a recurring deposit for 8 years. What is the amount you can expect to receive if the interest rate is 10%?



$$F = A\left[US - CAF\right]_{n=8}^{i=10\%}$$

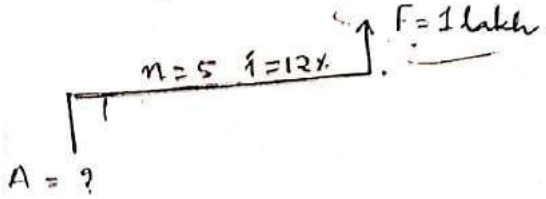
$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 7500\left[\frac{(1+0.1)^8 - 1}{0.1}\right]$$

$$= 7500 \times 11.43$$

$$= 85770/-$$

2. What amount a person should invest every year in order to get an lumpsum of 1 lakh @ the end of 5 years, if the interest rate = 10%?



$$A = F(US - SFF)_{n=5\text{yrs}}^{i=12\%}$$

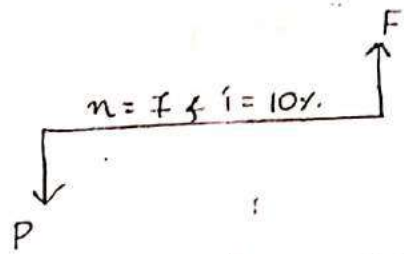
$$A = 1,00,000 \times 0.1574$$

$$A = 15,740/- \quad \text{every year.}$$

$$A = F(US - SFF)_{n=5\times12=60}^{i=\frac{12\%}{12}=1\% \text{ every month.}}$$

$$= 1,00,000\left[\frac{0.01}{(1+0.01)^{60} - 1}\right] = 1224/-$$

3) If a person borrows Rs 2,50,000/- now, what uniform amount (A) is he expected to pay every year, for next 7 years in order to repay the capital amount borrowed? i = 10%

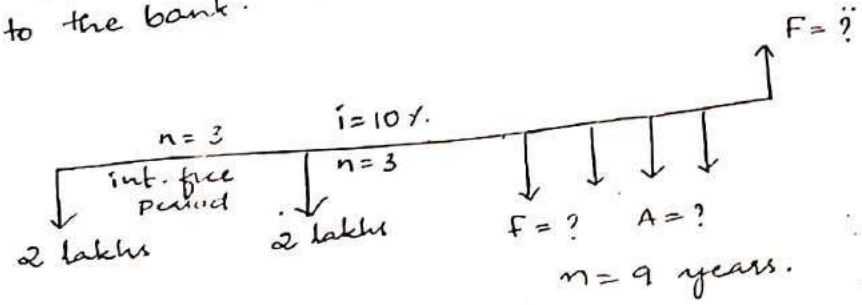


$$A = P[US - CRF]^{i}_{n}$$

$$= 2,50,000 \times 0.2054$$

$$= 51,350/-$$

4) A person secures a loan of Rs 2,00,000 @ a interest of 10%, compounded annually & starts an industry. The bank allows an interest free period of 3 years. Repayment starts after a further period of 3 years. Calculate uniform end of payment to liquidate the ~~dept~~ debt for a period of 9 years. What will be the total amount paid to the bank.



Solution. P = 2 lakhs, A = ?

i) $F = P(1+i)^{n}$

$= 2,00,000(1+0.1)^{3}$

$= 2,66,200/-$

Future worth for next 3 years before the start of repayment.

iii) Uniform end of year payment for 9 years.

$$A = P\left[US - CRF\right]_{n=9}^{i=10\%}$$

$$= 2,66,200 \times 0.1737$$

$$= 46,240/-$$

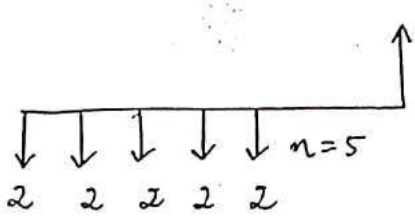
iv) Total Money Paid.

$$F = A\,(US - CAF)_{9}^{10\%}$$

$$= 46,240 \times 13.579$$

$$= 6,27,916/-$$

5. A student Recieves a loan of 2 lakhs. for every 5 year & he has been asked to pay full amount by further 5 years. what is the total amount he has to pay @ the end of 10 years.



i) $F = A\left[US - CAF\right]_{n=5}^{i=12\%}$

$$F = 2,00,000 \times 6.353$$

$$= 12,70,600/-$$

ii) $F = P\left(SP - CAF\right]_{5}^{12}$

$$= 12,70,600\,(1.762)$$

$$= 22,38,797/-$$

iii) $A = P\,(US - CRF)_{5}^{12}$

$$= 12,70,600 \times 0.277$$

$$= 3,52,464\ Rs$$

or

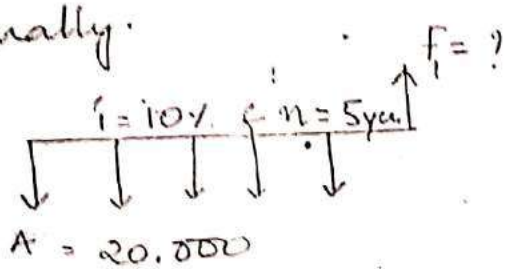
$$A = F\left[US - SFF\right]_{5}^{12}$$

$$= 22,38,797 \times 0.15$$

$$= 3,52,464\ Rs.$$

6. Rs 20,000 is invested today every year for a period of 10 years. What will be its value at the end of this period? If no further investment is made for a period of further 5 years what will be its value at the end of its period. Take i = 10% Annually.

i)



$$F_1 = A\left[US - CAF\right]_{n=5}^{i=10\%}$$

$$= 20,000 \times 15.937$$

$$= 3,18,740/-$$

ii)

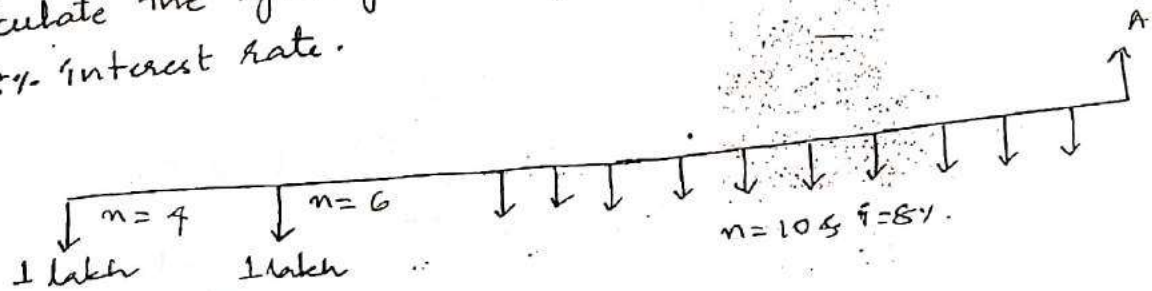
$$\therefore F_2 = P\left[SP - CAF\right]_{n=5}^{i=10\%}$$

$$= 3,18,740 \times 1.611$$

$$= 5,13,491/-$$

7. A person borrows Rs. 1 lakh from a bank to start an enterprise. For first 4 years he does not repay the loan. But at the end of 4 years he obtains a further loan of 1 lakh from the bank. After 6 years he starts repayment of both loans & clears them in a further period of 10 years. Calculate the yearly installment that he has to pay uniformly @ 8% interest rate.

Soln



$F_1 = A(SP - CAF)^{i=8\%}_{n=4}$

$F_1 = 1,00,000 \times 1.36$

$= 1,36,000/-$

$1,36,000 + 1,00,000 = 2,36,000/- = A_2$

$F_2 = 2,36,000 \times 1.587$

$= 3,74,532/-$

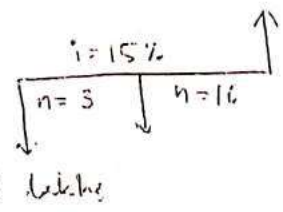
$F_2 = P$

$\therefore A = P[US - CRF]^{i=8\%}_{n=10}$

$= 3,74,532 \times 0.149$

$= 55,805/-$

∴ A person take a loan of 5 y. lakhs to start an industry @ a rate of 15%. He start liquidating ~~@ a Rate of 15%~~ loan for 3 years after borrowing & opt for uniform period of 16 years find the amount of each payment a) yearly b) Monthly



i) $F = 5,00,000 [SP - CAF]$

$= 5,00,000 \times 1.521$

$= 7,60,500/-$

$A = 7,60,500 [US - CRF]$

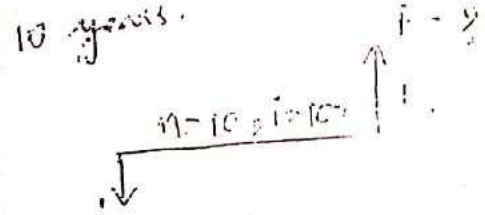
$= 7,60,500 \times 0.1680$

$= 1,27,767/-$ Annually

$A = 7,60,500 \left[\frac{[1+(16/12\%)]^{16\times12=192} \times 16/12\%}{(1+(16/12\%)^{192} - 1} \right] = 7,60,500 \times \frac{0.1552}{10.940}$

$= 10,788/-$

A person invest Rs. 1,000 in a bond for 10 years & at end of which period an amt equal to total accumulated is taken as a loan to start a business. What minimum income he has to earn so that the business is just able to cover the interest. i = 10% & he has to clear all his debt in 10 years.



$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 1,000 \times 15.937$$

$$= 15,937/-$$

$$F = P\left[\frac{(1+i)^n}{i}\right]_{i=10\%}^{n=10\text{ years}}$$

$$= 15,937 \times 0.1628$$

$$= 2,594/-$$

3 Methods of comparision.

In an investment climate there will always be quite a few alternatives available & we'll have to choose one of them. The problem will then be of comparing one alternative with another. Hence we need methods of comparision.

Before we make a comparision the expenditure & reciept associated with each & every alternate should be clearly estimated. These are done in the form of cash flow tables as shown below as an example:

EOY	Disbursement	Reciept	Nett Reciepti
0	-1,00,000	-	-1,00,000
1	-15,000	+45,000	+30,000
2	-17,000	+47,000	+30,000
3	-19,000	+47,000	+28,000
4	-20,000	+45,000	+24,000
5	-23,000	+46,000	+23,000

N.B : '+'ve sign → Receipt

'-'ve sign → Disbursement.

It may be noted that the amounts specified in the cash flow tables are estimates of anticipated reciepti or disbursements. As such, it is expected that they've been compiled to the best of one's abilities & infomation.

The cashflow table is the start of the problem in engineering economics. For each alternative there will be cash flow table.

I) Present Worth Method:

In this method all the items of net cash flow are brought to the present. It may be noted that present is denoted as EOY = 0. The proces of determining present worth of all future reciepti is also known, sometimes, as discounting & hence the present worth method is also called as "Discounted cash flow method"

Let the interest rate = 15%

Present worth of Projected cash flow } = PW

$$PW = -1,00,000 + 30,000(SP - PWF)^{i=15\%}_{n=1} + 30,000(SP - PWF)^{i=15\%}_{n=2}$$
$$+ 28,000(SP - PWF)^{i=15\%}_{n=3} + 24,000(SP - PWF)^{i=15\%}_{n=4}$$
$$+ 23,000(SP - PWF)^{i=15\%}_{n=5}$$

$$\therefore PW = -1,00,000 + 30,000 \times 0.8696 + 30,000 \times 0.7562 + 28,000 \times 0.65$$
$$+ 24,000 \times 0.5718 + 23,000 \times 0.4973$$

The sum -7657 represents "A single No". The equivalance of entire cash flow & its worth of the cash flow today. The negative sign indicates that @ 15% interest the project is not yielding adequate return & if 15% is the desired rate of return this cash flow fail to satisfy the requirement. In other wo the project is not viable @ 15% requirement.

We may for the sake of curiosity examine the cash-flow of table 1. for an interest rate of say 12%.

$$PW @ i = 12\% = -1,00,000 + 30,000 \times 0.8929 + 30,000 \times 0.7972 + 28,000 \times 0.7118 + 24,000 \times 0.6355 + 23,000 \times 0.5674$$

$$= -1064.4$$

The sign is still negative but the PW has increased from -7657 to -1064. The inference is that the project is still not viable for a return of 12%.

2. Annual Equivalent Method:

Instead of determining a single equivalent number occuring at the end of year "0", it is also possible to determin another number which occurs repeatedly at the end of each year, from end of year 1 to end of year 'n'. This is called "Annual Equivalent Method"

The AE of cash flow for table 1 for 15% interest is given by

$$AE_{@15\%} = -7657 (US - CRF)_5^{15} = -2284$$

EOY	PW	AE
0	-7657	-
1	-	-2284
2	-	-2284
3	-	-2284
4	-	-2284
5	-	-2284

* Used when no of years are not equal for comparision.

* Either the PW or AE represents the cash flow by a single

III Rate of Return Method:

The cash flow of table 1 as observed is such the the return of the project is 12% since @ 12% interest the PW is negative.

Often a question will be asked as to what is the exa rate of return of the project. This can be obtained by equating the PW of the cash flow to "0", for an unknown interest rate. The solution of the equation gives the rate of ret let us take previous example of PW,

$$-1,00,000 + 30,000 \times \frac{1}{(1+i)^1} + 60,000 \times \frac{1}{(1+i)^2} + 28,000 \times \frac{1}{(1+i)^3}$$

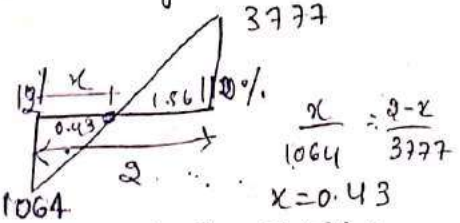
$$+ 24,000 \times \frac{1}{(1+i)^4} + 23,000 \times \frac{1}{(1+i)^5} = 0$$

The terms within the braketh are the present worth factors, This is a 5th degree equation in 'i' & as such 5 rooth are possibl But we are interested only in the real & positive rooth & not in imaginary & negative rooth.

The above equation cannot be solved directly, but it can be solved by trial & error.

for $i = 12\%$ PW = -1064

for $i = 10\%$ PW = 3777



$\frac{x}{1064} = \frac{2-x}{3777}$

$x = 0.43$

$\therefore$ by interpolation to obtain PW = 0 we get $i = 11.56\%$

$10 + 1.56\%$

It should be noted that determining rate of interest involves trial & errors & hence more computation. The "Rate of Return" is also called "internal Rate of Return" (IROR).

Q. For a project heavy trucks have to be brought. The details of 2 models are as follows.

Particulars	Model I	Model II
i) Capital cost	10,00,000	8,00,000
ii) Annual O&M	1,60,000	2,00,000
iii) Salvage value	1,80,000	80,000
iv) Life	8 years	8 years

if 8% interest, which of the 2 models is superior.

Model I

1) PW_1 → Capital cost
$= -10,00,000$

2) PW_2 → Annual O&M
$= -1,60,000 (US-PWF)^8_8$
$= -1,60,000 \times 5.7466$
$= -9,19,456/-$

3) PW_3 → Salvage value
$= +1,80,000 (SP-PWF)^8_8$
$= +1,80,000 \times 0.5403$
$= 54030/-$

$= -18,64,426/-$

Since PW of model 1 is better.

Model 1 is better.

Model II

$= -8,00,000$
$= -2,00,000 (US-PWF)^8_8$
$= -2,00,000 \times 5.7466$
$= -11,49,320/-$
$= +80,000 (SP-PWF)^8_8$
$= 80,000 \times 0.5403$
$= 43,224/-$

$= -19,06,096$

PW of model 2.

2. An engineer is in need of an automobile project site & finds that he can either lease or purchase as follows.

Item A - lease a car for 4500/- Per month paid monthly at the of each year moth for 2 years.

Item B - Purchase a car for 1,50,000/- & sell it after 2 years for ₹ 90,000

In both the cases engineer pays the owned money & insurance cost. Assume i = 1% monthly.

01

Given i = 1% for n = 24

US - PWF = 21.243

SP - PWF = 0.7876.

$P_1 = A[US - PWF]^{i=1}_{n=24}$

$= 4500[21.243]$

$= -95,593/-$

$P_2 = -1,50,000 \times 0.7876 + 90,000 \times 0.7$

$= -28,140/-$

$P_2 = -19,116$

$F = \left[\frac{(1+i)^n - 1}{i}\right.$

$= \left[\frac{(1+0.01)^{24} - 1}{0.01}\right.$

∴ Purchase of Car itself is worth.

ii) Annual Equivalent Method.

$AE_1 = -4,500 \times 12 = -54,000/-$

$AE_2 = -1,50,000 (CRF)^{i=12\%}_{n=2} + 90,000 (SFF)^{i=12}_{n=2}$

$= -1,50,000 \times 0.5917 + 90,000 \times 0.4717$

$= -46,302/-$.

4/3:
An engineer has a choice of paving with either type A or type B pavement. Type A pavement has life expectancy of 10 years. After which part of the material can be salvaged & reused. Type B pavement last only 5 years. But it is much less expensive. Which is the better alternative.

Particulars	Type A	Type B
a) Initial cost	20,000	5000
b) Annual cost	1,000	2000
c) Salvage value	2,500	—
d) Estimated life	10 years	5 years.

Soln

Type A : P.W of Type A Pavement

$$PW = -20,000 + (-1000(US-PWF)^{10}_{i=10\%} + 2500(SP-PWF)$$

$$= -20,000 - 1000 \times 6.1446 + 2500 \times 0.3856$$

$$= -25,180/-$$

Type B : PW of Type B Pavement.

$$PW = \cancel{-5000 + (-2000(US-PWF)^{10}_{10\%} + 0}$$

$$PW = -5000 - 5000(SP-PWF)^{5}_{10} - 2000(US-PWF)^{n=10}_{i=10}$$

$$= -5000 - 5000 \times 0.6209 - 2000 \times 6.1446$$

$$= -20,394/-$$

* For Better comparision increase type B to 10 years.

. A construction equipment can be purchased for 1,90,000/- on the basis of its production an annual income of 28,000/- is forcing for a period of 15 years. What annual rate of return is in Prospect. If the minimum attainable rate of return is 15% should the equipment be purchased.

Soln

Equating PW = 0.

$$-1,90,000 + 28,000 \times \frac{1}{(1+i)^1} + \dots + 28,000 \times \frac{1}{(1+i)^{15}} = 0$$

i.e $0 = -1,90,000 + 28,000\,(US - PWF)^{n=15}_{i=?}$

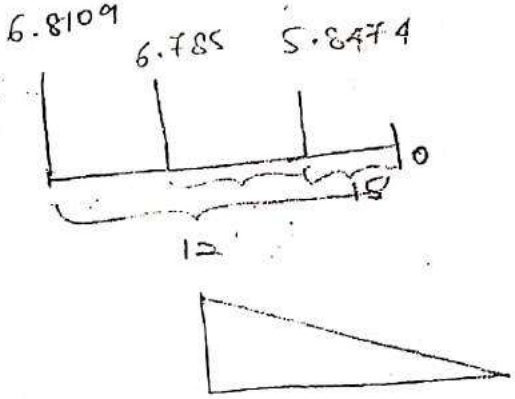
$$\frac{1,90,000}{28,000} = (US - PWF)^{i=?}_{n=15}$$

$$6.785 = (US - PWF)^{i=?}_{n=15}$$

@ i = 12% $\Rightarrow$ 6.8109

@ i = 15% $\Rightarrow$ 5.8474

$\therefore$ for 6.785 i = 12.07%



5. A prospective venture is described by the following reciept & disbursement

EOY	Reciept	Disbursement	Nett Receipt
0	0	-6000	-6000
1	1600	600	+1000
2	2000	500	+1500
3	2800	400	+2400
4	3200	200	+3000

for an $i = 12\%$ determine the desirability of the venture on the basis of PW comparision.

$$PW = -6000 + 1000 \times 0.8929 + 1500 \times 0.7972 + 2400 \times 0.7118 + 3000 \times 0.6355$$

$$= -296/-$$

As per the PW being negative, it is not desirable as it is not yielding adequate return.

6/8 (4)

While the method of comparision assist us in knowing the equiv of sums of alternatives we need a decision criteria in order to choose the best alternative. Some of the decision criteria that can be postulated are,

i) Maximize Present Worth.
ii) Maximize Annual Equivalent.
iii) Maximize Rate of Return.
iv) Incremental Present Worth analysis
v) Incremental A.E analysis
vi) Incremental ROR analysis.

They are best illustrated with example,

→ Cash flow of 3 alternatives are as shown below.

EOY	Alt 1	Alt 2	Alt 3
0	-50,000	-80,000	-1,00,000
1	+14,000	+19,000	+25,000
2	+14,000	+19.000	+25,000
⋮			
10	+14,000.	+19,000	+25,000.

Interest rate is 15%.

Soln

[Maximize Present Worth.

a) + PW (Alt 1) = $-50,000 + 14,000\,(US - PWF)^{15\%}_{10}$
$= -50,000 + 14,000 \times 5.0188 = 20,263/-$

b) PW (Alt 2) = $-80,000 + 19,000 \times 5.0188 = 15,357/-$

c) PW (Alt 3) = $-1,00,000 + 25,000 \times 5.0188 = 25,470/-$

Using Maximizing PW criteria Alt. 3 is the best. We can also see from inspection that annual equivalent of alt. 3 will be the heighest & this would satisfy the criteria for ... i.e. Annual equivalent i.e $AE = PW(US - CRF)^{i=15\%}_{n=10}$.

III. Maximize rate of return method.

→ equating PW of Alt 1 = 0.

$0 = -50,000 + 14,000 (US - PWF)^{i=?}_{n=10}$

solving $(US - PWF) = 3.571$

By trial & error $i = 25\%$

→ equating PW of Alt 2 = 0

$0 = -80,000 + 19,000 (US - PWF)^{i=?}_{n=10}$

solving $(US - PWF) = 4.2105$

By trial & error i lies between 20 & 15%.

→ equating PW of Alt 3 = 0

$0 = -\$1,00,000 + 25,000 (US - PWF)^{i=?}_{n=10}$

solving $(US - PWF) = 4$.

By trial & error $i = 21.54\%$.

using maximum ROR criteria, it is observed that alt 1, gives us maximum ROR

$i = 25\%$. Hence alt 1 is best option.

Incremental Analysis.

The incremental analysis is based on the principle that every rupee of investment is as good as the other. In a particu return, say the minimum acceptable rate of return is expecte of the next incremental investment over & above the first one & so on.

To carryout incremental Analysis certain systamatic procedure is needed. It is summerised as below.

1. The alternatives should be listed in the ascending order of their first cost [Initial cost]
2. The method adopt "Initial a Current Best" option.
3. In most cases this'll be the "do nothing" alternative.

Cash flow table are prepared on an incremental basis between the alternative which is being examined & the current best alternative.

4. Analysis proceeds from least initial cost alternative to the next higher one in intial cost & soon by one by one.

5. When an alternative which has just been examined is acceptable It becomes the "current best", Replacing the earlier one.

∴ The analysis can be terminated @ any level of investment if there is a limit on the availability of funds.

Based on the previous cash flow table, using incremental present worth & MARR as 15%.

1 → The initial current best alternative is "do nothing alternative".

In the ascending order of first cost, the next alternative is alt. 1.

Cash flow table for Alt 1 & Do nothing.

Alt 1 – Donothing

EOY	Nett Reciept
0	−50,000
1–10	+14,000

∴ PW = +20,263.

Since this is positive alt 1 is acceptable over do nothing alternative. Alt 1 becomes the current best.

The next in ascending order of the initial cost is Alt 2.

The incremental cash flow table for Alt 2 & Alt 1 are as follows.

EOY	Nett Reciept
0	−80,000 − (−50,000) = −30,000
1–10	5000

∴ PW = −30,000 + 5000 × 5.0188 = −4906/−

∴ Since PW is negative for Alt. 2 it is not acceptable.

Alt 1 remains the current best.

The next in the ascending order of initial cost is Alt. 3.

∴ Cash flow table b/w alt 3 - alt 1.

EOY	Net Reciept
0	-50,000
1-10	+11,000

PW = +5206/- since this is positive Alt 3 is acceptable & it also becomes current best. Since there is no other alternative available for further analysis, the procedure is terminated & hence alt. 3 is the best among all the three

18|3 Incremental analysis by ROR method.

1. ROR cash flow for alt 1 & do-nothing

EOY	Nett Reciept
0	-50,000
1-10	+14,000

equating $PW = 0 = -50000 + 14,000 (US - PWF)^{i=?}_{n=10}$

$\therefore (US - PWF)^{i=?}_{n=10} = 3.571$

By trial & error $i = 25\% > 15\%$. [Minimum acc. rate of return]

& hence becomes the current best.

comparing Alt 2 - Alt 1.

EOY	Nett Reciept
0	-30,000/-
1-10	5000

$PW = 0 = -30,000 + 5000 (PWF - US)^{i=?}_{10}$.

$\therefore (US - PWF)^{i=?}_{n=10} = 6$

By trial & error $i = 10.58\% < 15\%$ (MARR)

Alt. 2 is not acceptable & Alt 1 remains current best.

∴ Cash flow table alt 3 & alt 1.

EOY	Net Reciepts
0	−50,000
1-10	+11,000

∴ $PW=0 = -50,000 + 11,000\,(US - PWF)_{n=10}^{i=?}$

$(US - PWF) = 4.545$

by trial & error $i = 17.86\% > 15\%$.

& Hence Alt 3 is acceptable & is the Best.

Incremental analysis yields the same result weather the method of comparision is present worth or rate of interest.

2. A wholesale distributor is considering of a cont. of new warehouse to serve a geographic region, that he has not been able to serve till now. There are 6 cities where it can be built. After extensive study the expected income & cost associated with the location of the warehouse in a city have been determined as given in data. The life of warehouse is estimated as 12 years. If the min. AROR is 15%. where should the wholesaler locate his warehouse.

City	Initial Cost	Nett Annual Income
A	10,00,000	4,07,180
B	11,20,000	4,44,794
C	12,60,000	4,82,377
D	14,20,000	5,18,419
E	16,20,000	5,07,771
F	17,00,000	5,55,575.

A - do nothing.

EOY	Nett Reciept
0	-10,00,000
1-12	+4,07,180

$PW = -10,00,000 + 4,07,180\,(US\text{-}PWF)_{n=12}^{i=15}$

$PW = -10,00,000 + 4,07,180 \times 5.4206 = 12,07,160/-$

B - A

EOY	Nett Reciept
0	-1,20,000
1-12	37614

$PW = -1,20,000 + 37614 \times 5.4206$

$= +83,890$

∴ B = Current Best.

~~B~~ C - B

EOY	Nett Reciept
0	-1,40,000
1-12	37,583

$PW = -1,40,000 + 37583 \times 5.4206$

$= 63722/-$

∴ C = Current Best.

D - C

EOY	Nett Reciept
0	-1,60,000
1-12	36,042.

$PW = -1,60,000 + 36,042 \times 5.4206$

$= 35,369/-$

∴ D = Current Best.

E - D

EOY	Nett Reciept
0	-2,00,000
1-12	29,352

PW = $-2,00,000 + 29,352 \times 5.4206$

= $-40,894/-$

D is the current best.

F - D

EOY	Nett Reciept
0	-280,000
1-12	37,156

PW = $-2,80,000 + 37156 \times 5.4206$

= $-78,592/-$

∴ D is the current best.

Terminating @ this point Wholesaler Benifith if he starth @ city D.

i) Maximizing P.W.

A = $-10,00,000 + 4,07,180 \times 5.4206$ =

B = $-11,20,000 + 4,44,794 \times 5.4206$ =

C = $-12,60,000 + 4,82,377 \times 5.4206$ =

D = $-14,20,000 + 5,18,419 \times 5.4206$ =

E = $-16,20,000 + 5,07,771 \times 5.4206$ =

F = $-17,00,000 + 5,55,575 \times 5.4206$ =

2614772 2411650
9101422207159

A state highway department has identified 6 new locations for its expansions. The table below provides an estimate of cost of construction, Annual O&M & user benifitt cost associated with each location. The highway is expected to last for 25 yrs. Take i=

location	cost of const^n	O&M	User Benifitt cost
A_1	8,00,000	5221	2, 40, 000
A_2	9,00,000	4920	2, 33, 206
A_3	10,00,000	4630	2, 27, 789
A_4	11,00,000	4255	2, 13, 507
A_5	12,00,000	3540	1, 97, 613
A_6	13,00,000	3412	1, 89, 918

Solve by incremental analysis.

payment, he sells the car for Rs. 4,50,000. Draw two CFD's one for Aran and one for ICFC Bank, for the above cash flows.

11. Suppose Rs. 14000 is deposited at the beginning of each year into a bank account, that pays interest annually at 10% for 12 years. How much would be accumulated in the account by the end of the 12th year?
12. An amount of Rs. 1200 per year is to be paid into an account each for the next five years. Using a nominal interest of 12% determine the total amount the account will have at the end of 5th year under the following conditions.
    (i) Deposit made at the end of each year with interest compounded monthly.
    (ii) Deposit made at the end of each year with interest compounded continuously.
13. A person borrows Rs. 1000 on loan at a simple interest rate of 10% per annum for 8 years. What will be the compound interest rate if he has to pay the same amount after 5 years?
14. The rights to a patent have been sold under an agreement in which annual year end payments of Rs. 400,000 are to be made for the next 10 years. What is the future sum of this annuity? What is the present worth of the annuity at an interest rate of 7 percent?
5. A company has to replace a present facility after 15 years at an outlay of Rs. 56,00,000. It plans to deposit an equal amount at the end of every year for the next 15 years at an interest
6. A milk distributor plans to purchase a small delivery van at the cost of Rs.5,00,000/- to be used for 8 years. The maintenance and operating cost is estimated to be Rs.35000 /- per year which will increase at Rs. 3000 /- per year. If the vehicle has a salvage value of Rs. 50,000 . find the present worth of the vehicle at $i = 12\%$.
7. A commercial rental properly is for sale at Rs. 15 lakhs. A prospective buyer estimates that the property would be held for 10 years and could be sold at Rs. 12 lakhs at the end of the period. During the ownership the annual rental receipts would be Rs. 1,50,000 and disbursements would be Rs. 60,000 /-. If the rate of return is 9% what is the maximum bid the purchaser should make to buy this property?

A company is evaluating three CNC machines of different makes for possible use in its facility, to purchase any one of them. If the technological life is 3 years at $/ = 12\%$ which machine is preferable assuming all other factors are equal. Use a net present worth evaluation.

Description, Rs	CNC-A	CNC-B	CNC-C
First cost	5,50,000	5,80,000	5,30,000
O & M cost	35000 / year	46000 / year	40,000 / year
Income expected	4,00,000 / year	4,40,000 / year	3,90,000 / year
Salvage value	40,000	60,000	40,000

Mod-5

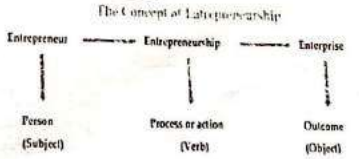
5 ENTREPRENEURSHIP, MSME & BUSINESS PLANNING PROCESS

Entrepreneurship: *Evolution of the concept, functions of an entrepreneur, concepts of entrepreneurship, stages in entrepreneurial process, different sources of finance for entrepreneur, central and state level financial institutions.*

Micro, Small & Medium Enterprises (MSME): *definition, characteristics, objectives, scope, role of MSME in economic development, advantages of MSME, Introduction to different schemes: TECKSOK, KIADB, KSSIDC, DIC, Single Window Agency: SISI, NSIC, SIDBI, KSFC*

Business Planning Process: *Business planning process, marketing plan, financial plan, project report and feasibility study, guidelines for preparation of model project report for starting a new venture. Introduction to international entrepreneurship opportunities, entry into international business, exporting, direct foreign investment, venture capital*

5.1 MEANING OF ENTREPRENEUR



The definition of entrepreneurship has been debated among scholars, educators, researchers, and policy makers since the concept was first established in the early 1700's. The term "entrepreneurship" comes from the French verb "entreprenerd" and the German word "unternehmen", both mean to "undertake".

Schumpeter's Definition —The entrepreneur in an advanced economy is an individual who introduce something new in the economy- a method of production not yet tested by experience in the branch of manufacturing, a product with which consumers are not yet familiar, a new source of raw material or of new markets and the like"

Drucker's Views on Entrepreneur "An entrepreneur is the one who always searches for change, responds to it and exploits it as an opportunity. Innovation is the specific tool of

entrepreneurs, the means by which they exploit changes as an opportunity for a different business or different service"

The term entrepreneur is often associated with a person who starts his own new business. Business encompasses manufacturing, transport, trade and all other self-employed vocation in the service sector.

Entrepreneurship has been considered as the propensity of mind to take calculated risk with confidence to achieve predetermined business objectives.

5.2 EVOLUTION OF CONCEPT OF ENTREPRENEUR

The word 'entrepreneur' is derived from French word 'Entreprendre' which was used to designate an organizer of musical or other entertainments. Later in 16th century it was used for army leaders. It was extended to cover civil engineering activities such as construction in 17th century. But it was Richard Cantillon, an Irishman living in France who first used the term entrepreneur to refer to economic activities. According to Cantillon "An entrepreneur is a person who buys factor services at certain prices with a view to selling its product at uncertain prices". Entrepreneur, according to Cantillon, an entrepreneur is a bearer of risk, which is non-insurable. SchumPeter gave a central position to the entrepreneur who believed that an entrepreneur was a dynamic agent of change; that an entrepreneur was a catalyst who transformed increasingly physical, natural and human resources into correspondingly production possibilities. Since then the term entrepreneur is used in various ways and various views.

5.3 FUNCTION OF ENTREPRENEUR

An entrepreneur does perform all the functions necessary right from the genesis of an Entrepreneur idea up to the establishment of an enterprise. These can be listed in the following sequential manner:

- Idea generation and scanning of the best suitable idea.
- Determination of the business objectives.
- Product analysis and market research
- Determination of form of ownership/organization.
- Completion of promotional formalities.
- Raising necessary funds.
- Procuring machine and material.
- Recruitment of men.

From above listing we can further classify the function under three main categories

1. **Risk-bearing:** Entrepreneur as an agent who buys factors of production at certain prices in order to combine them into a product with a view to selling it at uncertain prices in future. He illustrated a farmer who pays out contractual incomes which are certain to the landlords and laborer's and sells at prices that are 'uncertain'. He further states that so do merchants also who make certain payments in expectation of uncertain receipts. Thus, they too are 'risk-bearing' agents of production.

2. **Organization:** entrepreneur with the functions of coordination, organization, supervision. According to him, an entrepreneur is one who combines the land, the labor of another and the capital of yet another, and, thus, produces a product selling the product in the market, he pays interest on capital, rent on land and to laborer's and what remains is his/her profit.

3. **Innovation:** Schumpeter considered economic development as a discrete change brought by entrepreneur by instituting new combinations of production *i.e.*, innovations. The introduction of new combination of factors of production according to him, may occur in anyone of the following five forms:
   - The introduction of a new product in the market.
   - The instituting of a new production technology which is not yet tested experience in the branch of manufacture concerned.
   - The opening of a new market into which the specific product has not previously entered.
   - The discovery of a new source of supply of raw material.
   - The carrying out of the new form of organization of any industry by creating monopoly position or the breaking up of if ideas and craftsmanship

5.4 ROLE OF ENTREPRENEURSHIP IN ECONOMIC DEVELOPMENT

Economic development essentially means a process of upward change whereby the per capita income of a country increases for a long period of time. The crucial role played by the entrepreneurs in the western countries has made the people of underdeveloped countries conscious of the significance of entrepreneurship in economic development. After the Independence, India has realized the necessary to increase the entrepreneurship both qualitatively and quantitatively in the country.

Parson and Smelter described entrepreneurship as one of the two necessary conditions for economic development, the other being increased output of capital.

Y.A. Say high describes entrepreneurship as a necessary dynamic force for economic development.

The important role that an entrepreneurship plays in the economic development of economy can be put more systematically as follows.

1. Entrepreneurship promotes capital formation by mobilizing the idle savings of public.
2. It provides immediate large-scale employment. Thus, it helps to reduce unemployment in the country.
3. It provides balanced regional development.
4. It helps reduce the concentration of economic power.
5. It stimulates the equitable redistribution of wealth, income and even political power in the interest of the country.

6. It encourages effective resources mobilization of capital and skill which might otherwise remain unutilized and idle.
7. It also induces backward and forward linkages which stimulated the process of economic development in the country.
8. It promotes country's export trade i.e. an important ingredient for economic development.

5.5 STAGES OF ENTREPRENEURIAL PROCESS:

Stages of entrepreneurial process involves the following

a) **Identification of an opportunity**
b) **Evaluation of the opportunity**
c) **Preparation of the business plan**
d) **Determination and organizing the resources**
e) **Management of enterprise**

a) **Identification of opportunity:** First step in entrepreneual process, this may be done from his own idea or from external sources. Like consumers and business associates, members of distribution system, independent technical organizations, consultants, etc. Consumers are best sources of ideas. Some government organization and R & D provides new ideas

b) **Evaluation of opportunity**: Opportunity identified from sources must be carefully screened and evaluated. Evaluation process involves looking at length of opportunity. Length of opportunity and market size and shares are two main aspects for deciding risk and gains or profits. SWOT (Strength, Weakness, Opportunities and Threats) analysis is useful analysis tool Strength & Weakness are internal factors related to organization. Operations & Threats are external factors related to environment and competition

c) **Development of business plan:** To achieve proposed business opportunity, well defined business plan need to develop. Business plan contains, Title of project, Description of business and industry, Technology plan, Financial plan, Organization of plan, Production & Marketing & Distribution plan and Summary plan

d) **Determination and organizing resources:** Begins with assessment of present resources. Organizing the required resources at the appropriate time is another important aspect of entrepreneurial process. Alternative sources of supply, process of manufacture, are to be planned

e) **Management of enterprise:** After resources are acquired, the entrepreneur must use them to implement the business plan. Operational problems of growing enterprise must also be examined.

5.6 ENTREPRENEURSHIP IN INDIA

The Early Phases: Pre - Independence

- Before the advent of the Moguls India was known as the land of the —The Golden Bird' symbolizing the best in all forms of living due to a rich heritage of trade and commerce which has resulted in amassing of the substantial wealth in the sub-continent.
- It was with the British colonization that the wheel of entrepreneurship came to a grinding halt. The government not only discontinued patronage to the industries but took extreme steps to ensure the death of the entrepreneurial spirit of the nation.

Post-Independence:

- The arrival of independence could not infuse much life into the business community and most of the industries stayed limited to urban areas of Calcutta, Bombay, Ahmed ibad and Madras in the first decade.
- During 1960's it saw a huge emphasis on government sponsored heavy industries without much attention to the small and medium units that some struggling entrepreneurs were desperately trying to establish. There were several small-scale industries which sprouted to provide ancillary support to the large industries but more than 40 % of those turned sick within a very short span of time.
- In 1970's some initiative by the government was taken in encouraging export-oriented industries as a desperate measure to enhance foreign exchange reserves. There was a miniscule improvement in the overall business environment primarily.
- In 1990's the economic crisis at the start of the decade called for immediate and sustained efforts to liberalize the economy. The government policy to move towards a market-oriented economy heralded the beginning of a new era which saw immediate success in terms of boost to the national economy within the first few years.
- During 21st Century Indian entrepreneur was ready to take on the world. Encouraged by the initial success of the nineties even the government was more than willing to lend a supporting hand to the SMEs. The availability of a large and trained workforce at competitive prices the Indian enterprise looked most challenging and soon spread tentacles across the globe. The typical Indian ingenuity in reducing costs and working harder ensured that SMEs in India could compete with MNCs on a level playing ground.
- The new era also had the huge advantage in terms of easy availability of capital. The economy was growing double figures year after year. Another boon for the Indian SMEs was the arrival of service-oriented business concept which was strongly backed by technological advancements which facilitated outsourcing of work overseas. The Indian Entrepreneur had truly arrived on the global scene not because of the government but despite it.
- A host of favorable programs and policies that help and encourage the SMEs have been instituted over the past few years which have also contributed significantly

in this direction. The government has set up independent financing agencies such as the SIDBI and NABARD which provide exclusive financial assistance to the small and medium industries. Easy availability of capital with subsidies and suitable moratorium on repayment is supporting these ventures in the startup stage.

- Successful entrepreneurs such as Azim Premji, Narayana Murthy and Dhirubhai Ambani have inspired a whole new generation to look forward into the future with unbounded hope even if they don't have the influence or inheritance to back them. The Indian entrepreneur is all set to achieve new heights of success and growth in the years to come.

5.7 BARRIERS TO ENTREPRENEURSHIP.:

Some of the Barriers of Entrepreneurship is as given below:

a) **Salary:** Starting your own business means that you must be willing to give up the security of a regular pay check.

b) **Benefits:** There will undoubtedly be fewer benefits, especially when considering that your business will be just starting off.

c) **Work schedule:** The work schedule of an entrepreneur is never predictable: an emergency can come up in a matter of a second and late hours may become the norm.

d) **Administration:** All the decisions of the business must be made on his/her own; there is no one ranked higher on the chain of command in such a business, and the fear of a wrong decision can have its own effect.

e) **Incompetent staff:** Most of the time, the entrepreneurs will find themselves working with employees who "don't know the ropes" as well as they do, due to lack of experience.

Few other barriers of entrepreneurship are:

- Lack of capital
- Lack of technical knowledge
- Economic business cycles
- Non-availability of raw materials &resources
- Government regulations
- Globalization and entry of foreign goods
- Risk
- Unstable and unpredictable markets
- Obsolescence of technology or idea

5.8 SUPPORTING AGENCIES OF GOVERNMENT FOR SSI

The Central Government through its ministry of Small-Scale Industries, and State Governments have started many agencies-both at Central and State levels, infrastructure and support services to small enterprises. A classification of all such are:

I. Central Level Institutions

1. DI: Directorate of Industries. It is involved in promotion of small scale units state level.
2. DIC: District Industries Centre: It promotes development of Khadi and other industries.
3. SIDO: Small Industries Development Organization. It mainly acts as a nodal and an interface between Central and State Governments. It also gives technical and consultancy services.
4. NSIC: National Small Industries Corporation Ltd.
5. NSTEDB: National Science and Technology Entrepreneurship Development. This agency promotes usage of Science and Technology in SSI sectors.
6. NPC: National Productivity Council. This agency suggests various ways improving productivity.
7. NISIET: National Institute for Small Industry Extension and Training. It high quality training to budding as well as existing entrepreneurs. It is in Hyder
8. NIESBUD: National Institute for Entrepreneurship and small Business Develop It co-ordinates the efforts of various agencies involved in entrepreneu development. It is in New Delhi.
9. IIE: Indian Institute of Entrepreneurship. It aims to Carry out researc development activities in entrepreneurship studies. It is located in Guwahati.
10. EDII: Entrepreneurship Development Institute of India. It is an autonomous sponsored by financial institutions like IDBI, ICICI etc. and engaged in spreadin and inspiring entrepreneurship movement in India. It is in Ahmedabad.

II. State Level Institutions

1. SSI BOARD: Small Scale Industries Board. It is the apex advisory body to the Government in matters related to small scale sector in the country.
2. KVIC: Khadi and Village Industries Commission.
3. SFC: State Financial Corporation. It provides finance support for starting SSI
4. SIDC: State Industrial Development Corporation. It promotes infrastruc facilities.
5. SSIDC: State Small Industrial Development Corporation. It helps small sca units in procurement of scarce raw materials. It also gives other services.

2) **Decide on the Constitution:** To start any enterprise, the promoters have to decide on the constitution of the unit. There are 3 major alternatives:
a) Proprietary b) Partnership c) Company
The alternatives must be decided at the initial stages of the project and necessary formalities should be completed by the time the application for Provisional Registration Certificate (PRC) is made to DIC (District Industries Centre).

3) **Obtaining SSI Registration:** Entrepreneurs desiring to start a small enterprise have to initially obtain a Provisional Registration Certificate. Once the unit goes into production, the PRC has to be converted into a Permanent Registration Certificate (PMT).

a) **PRC:** This is the initial registration required for starting a micro and small enterprise. The entrepreneur has to apply and obtain a PRC after selection of the project and deciding on the location of the unit. This application is necessary for obtaining the infrastructural facilities such as land, shed, power, etc and also for finance from the financial institutions.

b) **PMT:** A micro or a small enterprise can get a permanent registration certificate when it actually commences commercial production/service. PRC would be converted to PMT when the unit commences its commercial activities.

PMT Registration will help in several ways as the following:

- To apply for scarce raw materials and for imported raw materials.
- To get working capital loan from banks/financial institutions.
- To get central excise duty concessions.
- For claiming incentives, concessions, including sales tax exemption wherever applicable.
- To apply for registration under government stores purchase programs/ancillary development programme/export promotion program and to get purchase and price preference.

4) **Specific Clearances:** There are a number of statutory clearances required to start micro and small enterprises.

Some of them are as follows :

a) Agricultural land conversion into non – agricultural land (NA conversion).
b) Building plan approval by the local authorities.
c) Factories act and labor department.
d) Trade license from the local authorities.
e) Pollution control board clearances.
f) Food adulteration act license.
g) BIS certification wherever applicable, etc.

5) **Land or Shed Selection:** For any industrial project, suitable industrial site or a ready industrial shed is required. The promoters of the unit could consider taking an industrial site and constructing a shed as per their requirement, alternatively, could consider taking a ready industrial shed on ownership basis also.

6) **Plant and Machinery:** This requirement for a project could be purchased from recognized manufacturers/dealers. This could also be taken on hire basis operated by National Small Industries Corporation Limited.

7) **Infrastructure Facilities:** For micro or small enterprises, the main infrastructure facilities are land or shed for the project, power connection, water supply and telephone & internet facility. District level single window agency assists the entrepreneur in getting all the above facilities.

8) **Project Report:** For any new project or enterprise to be set up, proper planning is necessary. A detailed project report provides such a plan for the project. The report is useful to the entrepreneur for planning and implementing the project. This is essential for obtaining finance and other clearances for the project. In fact, the project report gives a detailed insight of the techno–economic viability of the project. This is generally prepared to cover the following:

1) Introduction.
2) Entrepreneurs (Promoters) background (education, experience, special achievements etc.).
3) Details of product(s) to be manufactured and their specifications/details of service(s) to be rendered with technical details.
4) Market potential for the product(s)/Service(s) and marketing plan.
5) Plant capacity, production plan and manufacturing process.
6) Infrastructure needed for the project.
7) Raw materials and consumable needed for the project.
8) Plant and machinery for the project (description, capacity, Cost, etc.).
9) Manpower requirements.
10) Total project cost.
11) Means of finance.
12) Income, costs and profitability projections.
13) Financial analysis.
14) Schedule of implementation.
15) Conclusions and recommendations.

9) **Finance:** Finance for such Projects are under 2 main categories :

a) Term Loan.
b) Working Capital Loan.

(a) Term Loan: For starting a small enterprise, term loan finance for the fixed assets like land, building, plant and machinery, etc ., can be availed. This Loan can be availed from Karnataka State Financial Corporation (KSFC) or from the commercial banks. Financial institutions sanction up to 75% of the total investment on fixed assets and the balance of 25% has to be pooled in by the promoters as margin money. At present the lending interest rates are between 13% to 14% and also subject to change. Promoters can also approach National Small Industries Corporation (NSIC) for financial assistance.

(b) Working Capital Loan: It is always preferable to approach commercial banks for working capital loan. All commercial banks finance up to 75% of the working capital loan and the remaining 25% has to be pooled in by the promoters. It is important to note that banks will release working capital loan only after the promoters have contributed their share of 25%. at present the lending rates are varying between 13% to 14%.

c) single window scheme (SWS) of KSFC for both term loan and working capital loan: This loan scheme is for providing assistance to new micro and small enterprises whose project cost (excluding working capital margin of the promoters) does not exceed Rs. 50 Lakh and the total working capital requirements at the normal level of operation is up to Rs. 20 Lakh. Term Loan for fixed assets and term loan for working capital is fixed based on the debt equity ratio of 2:1 for loans above Rs. 10 Lakh and 3:1 for Loans up to Rs. 10 Lakh.

10) **Implementation of the Project:** The entrepreneurs will have to take necessary steps to physically implement the project after obtaining the various licenses, clearances, infrastructural facilities, etc. Following are the major activities that the entrepreneurs have to undertake for implementing the project.
   a) Construction of shed.
   b) Order for machinery.
   c) Arrange for raw materials .
   d) Marketing .
   e) Erection and commissioning.
   f) Obtain final clearances.

5.11.1 ROLE OF SSI IN ECONOMIC DEVELOPMENT

Economic development is defined in a number of ways; the commonest definition could be 'an increase in real per capita income of a person resulting in improvement in the levels of living'. The developments of small-scale industries contribute to the increase in per capita income. The role of SSI in economic development is given below.

1. Employment SSI use labour intensive techniques and therefore provide employment on a large scale, SSI accounts for 75% of the total employment in the industrial sector. SSI provides self-employment to artisans, technically qualified persons and professionals. These industries also offer employment to farmers when they are idle.
2. Optimization of Capital SSI requires less capital per unit of output and provides quick returns on investment due to shorter gestation period. Small scale units help to molatise small and scattered savings and channelise them into industrial activities.
3. Balanced Regional Development SSI promotes decentralized development of industries. They help to remove regional disparities by industrializing rural and backward areas. They also help to improve the standard of living in suburban and rural areas.

4. Mobilization of Local Resources SSI helps to mobilize and utilize local resources like small saving, entrepreneurial talent etc. which might otherwise remain idle or unutilized. These industries facilitate the growth of local entrepreneurs and self-employed professionals in small towns and villages.
5. Export Promotion SSI helps in reducing pressure on the country's balance of payments in two ways. First they do not require imports of sophisticated machinery or raw materials. Secondly. SSI can earn valuable foreign exchange through exports. There has been a substantial increase in exports from the small scale sector.
6. Consumer Surplus SSI now produces a wide range of mass conception items. Over 5000 products are being manufactured in small scale sector. About one-half of the output of manufacturing sector in India comes from small scale industries.
7. Feeder to Large Scale Industries SSI plays a complementary role to large scale sector. They provide parts, components, accessories etc. to large scale industries. They serve as ancillary units.
8. Social Advantage Small scale sector contributes towards the development of socialistic pattern of society by reducing concentration of income and wealth. They provide an honorable and independent living to people with limited resources. They facilitate wide participation of public in the process of development.
9. Share in Industrial Production SSI contributes more than one-half of the total industrial production in India. About 5000 products are manufactured in the small scale sector.
10. Development of Entrepreneurship Small scale units have helped to develop a class of entrepreneur. These units facilitate self-employment and spirit of self-reliance in the society.

5.12 INSTITUTIONAL SUPPORTING BUSINESS ENTERPRISES

The ministry of small scale industrial is the administrative ministry in the government of India for all matters relating to small scale and village industries. its designs and implements policies and programmes thought its filed organization and attached offices for promotion and the growth of small scale industries. The department of Small scale industries and agro and rural industries was created in 1991, in the ministry of industry to exclusively formulate the policy framework for promoting and developing small scale industries in the country.

Different Schemes:

5.12.1 SMALL INDUSTRIAL DEVELOPMENT BANK OF INDIA (SIDBI)

Established in April 2, 1990 under an act of Indian parliament as a principal financial institute. It is subsidiary of IDBI. It has head office at Lucknow. It is now among the development banks in the world.

III. Other Agencies.

There are a number of other agencies-both Central and State level - which directly or indirectly help the cause of Small Scale sector in India, mainly in financial and Industrial domain. They are:

1. **SIDBI:** Small Industries Development Bank of India.
2. **NABARD:** National Bank for Agricultural and Rural Development.
3. **HUDCO:** Housing and Urban Development Corporation Ltd.,
4. **NGO's:** Non-governmental Organizations.
5. **EPC:** Export Promotion Council.
6. **CII:** Confederation of Indian Industries.
7. **FICCI:** Federation of Indian Chambers of Commerce and Industry.
8. **ASSOCHAM:** Associated Chamber of Commerce and Industry of India.
9. **WASME:** World Association for Small and Medium Enterprises.
10. **LUB:** Laghu Udyog Bharati.
11. **ICSI:** Indian Council of Small Industries.
12. **CSIR:** Council of Industrial and Scientific Research.

5.9 INTRODUCTION TO MSME

Micro, Small and Medium Enterprises (MSME) sector has emerged as a highly vibrant and dynamic sector of the Indian economy over the last six decades. MSMEs not only play crucial role in providing large employment opportunities at comparatively lower capital cost than large industries but also help in industrialization of rural & backward areas, thereby, reducing regional imbalances, assuring more equitable distribution of national income and wealth. MSMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country. Ministry of Micro, Small & Medium Enterprises (M/o MSME) envision a vibrant MSME sector by promoting growth and development of the MSME Sector, including Khadi, Village and Coir Industries, in cooperation with concerned Ministries/Departments, State Governments and other Stakeholders, by providing support to existing enterprises and encouraging creation of new enterprises.

5.9.1 DEFINITION OF MICRO AND SMALL ENTERPRISES,

Definitions of Micro, Small & Medium Enterprises In accordance with the provision of Micro, Small & Medium Enterprises Development (MSMED) Act, 2006 the Micro, Small and Medium Enterprises (MSME) are classified in two Classes:

1. **Manufacturing Enterprises-**he enterprises engaged in the manufacture or production of goods pertaining to any industry specified in the first schedule to the industries (Development and regulation Act, 1951) or employing plant and machinery in the process of value addition to the final product having a distinct name or character or use. The Manufacturing Enterprise are defined in terms of investment in Plant & Machinery.

2. **Service Enterprises:** -The enterprises engaged in providing or rendering of services and are defined in terms of investment in equipment.

Manufacturing Sector	
Enterprises	Investment in plant & machinery
Micro Enterprises	Does not exceed twenty-five lakh rupees
Small Enterprises	More than twenty five lakh rupees but does not exceed five crore rupees
Medium Enterprises	More than five crore rupees but does not exceed ten crore rupees
Service Sector	
Enterprises	Investment in equipments
Micro Enterprises	Does not exceed ten lakh rupees:
Small Enterprises	More than ten lakh rupees but does not exceed two crore rupees
Medium Enterprises	More than two crore rupees but does not exceed five core rupees

5.10 CHARACTERISTICS

"Small scale industry is beautiful" because of its following important characteristics:

(1) A small-scale unit is generally a one-man show. Even in the small units which are run by a partnership firm or company, the activities are mainly carried out by one of the partners or directors. In practice, the others are simply called as sleeping partners or directors who mainly assist in providing funds

(2) In small-scale industries, the owner himself /herself is a manager also. Thus, these units are managed in a personalized fashion. The owner has firsthand knowledge of what is going on in the business

(3) Compared to large units, a small scale industrial unit has a lesser developmental period, i.e. the period after which the return on investment starts. etc.

(4) The scope of operation of small industrial undertakings is generally localized to the local and regional demands

(5) Small units use indigenous resources and therefore, can be located anywhere subject to the availability of these resources like raw materials, labor, etc.

(6) Small industries are labor intensive with comparatively smaller capital investment than the larger units. Small scale units require very little capital. About six or seven hundred rupees would get an artisan family started

(7) Small units are decentralized and dispersed to rural areas. Thus, the development of small-scale industries in rural areas promotes more balanced regional development and prevents the rush of job seekers from rural areas to cities and urbanizing centers

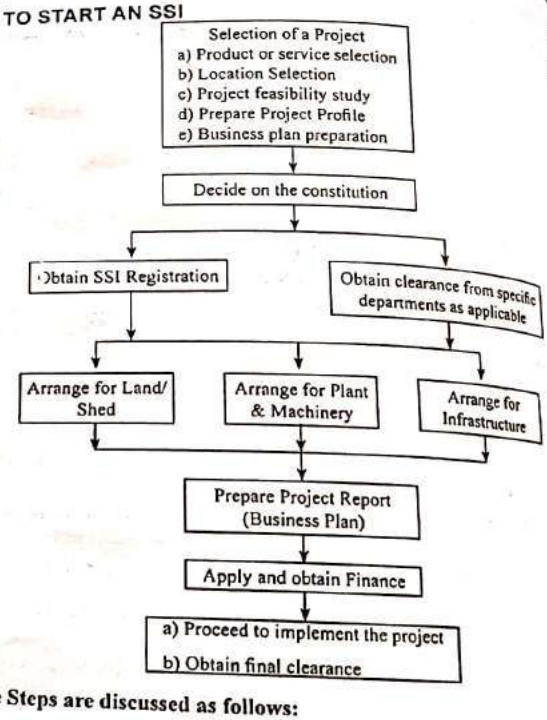
(8) Compared to large scale units, small-scale units are more change susceptible and highly reactive and receptive to socio-economic conditions. They are more flexible to adapt changes like introduction of new products

5.10.1 ADVANTAGES OF SSI

- As per the convenience of the owner in terms of space, finance, product and manpower, the SSI can be started
- The setting up of the unit and starting of production requires a small gestation period of only 2 to 6 months and layout can be made as per convenience
- Locally available skilled and semi-skilled people can be appointed at short notice and at a much lower wage compared to the medium and large industries. Wherever high technology is involved, the parent company executives will help. Alternatively, to sort out technology related problems consultants can be hired
- It is one of the best forms of self-employment as well as giving employment opportunities to own kith and kin, friends and relatives etc.
- In case of rural sector, the SSI units will be able to have cheaper labor especially in off seasons
- In developing countries, the SSI units are a necessity to assist bigger industries and new projects. Thus, they not only contribute to the economy of the nation but also create employment opportunities to people around the project sites
- In case of SSI units started by experienced and talented executives, there is abundant scope to develop high technology components for MNCs and to organize exports
- Due to increase in population there has been increase in production of consumer goods and Fast-Moving Consumer Goods (FMCG). In view of this there is a bigger role for small industries to take up components production and even manufacture the product itself
- The small units are exempted from excise duty up to 75 lakhs per annum turnover. Thus, lot of paper work and formalities are avoided

5.11 STEPS TO START AN SSI

STEPS TO START AN SSI



The Steps are discussed as follows:

1) **Project Selection:** Entrepreneur is the most important person for the success of a project. To set up a small enterprise, the entrepreneur must decide or choose a suitable project. The entrepreneur has to also decide on a suitable location for the project. Based on these selections, a project feasibility study must be conducted and then a brief project profile must be prepared for the proposed project.

The project selection and the preliminary activities involve the following:

a) Product or Service Selection
b) Location Selection
c) Project Feasibility Study
d) Preparation of Project Profile
e) Business Plan Preparation

bjectives:

- To promote finance and develop small scale sector in India
- To co-ordinate the functions of other institutions engaged in similar activities
- To finance industrial infrastructure projects

ctivities/functions include

- Technology upgradation
- Extending channels for marketing the products in SSI sector
- Promotion of employment-oriented industries especially in semi-urban areas
- Refinancing of loans and advances extended by primary lending institutions
- Discounting and rediscounting of bills
- Extension of speed capital/soft loan assistance, under valuation equity fund, seed capital under Mahila Udyam Nidhi scheme
- Grading direct assistance and refinance for financing exports of SSI sectors
- Extending financial support to SSIDC
- Extending financial support NSIC
- Providing leasing services

Few of the schemes of various initiative taken by government are given below:

5.12.2 KARNATAKA STATE SMALL SCALE INDUSTRIES DEVELOPMENT CORPORATION (KSSIDC)

It was established in 1960 by government of Karnataka. KIADB (Karnataka industrial area development board), a part of KSSIDC, acquires land for industrial purpose, develops and allots developed places for entrepreneurs. KSSIDC has promoted establishment of ancillary units to help PSUs like BEL, ITI, HAL, NGEF, BEML, etc., It has constructed 86 plots for SC/ST entrepreneurs. It has established 98 industrial estate in all districts and major taluks. Industrial estates have other infrastructure like roads, drainage, street light, water supply and common service buildings like bank, post office, canteen, etc. It provides ready built sheds and small plots and has made them available for allotment for entrepreneurs. It has opened raw material depot in all districts of state. Its regional offices are in Bangalore, Mysore, Belgaum, Gulbarga, Hubli, Tumkur, Shimoga and Mangalore.

Objectives

- To promote and develop SSI in state
- Construction and utilization of infrastructure, especially in backward areas, procurement and marketing raw materials, technical support and assistance
- To take up activity aimed at rapid development of SSI

Functions

- To establish and manage industrial estates
- To procure and distribute scare and rare raw materials to various SSI

- To provide assistance towards marketing of product from various SSIs
- To organize national level and international level exhibition and facilitate exchange of information
- To supply machinery and hire purchase scheme
- Provide guidance to SSI entrepreneurs
- Provide technical library facilities to help entrepreneurs
- Provide laboratory facilities in co-ordination with Indian Standard Institute

5.12 3. STATE FINANCE CORPORATION (SFC)

It was set up in 1948 to provide financial assistance to medium and large-scale industries. Later by 1951 role was extended to assist SSI. The first SFC was set up in Punjab in 1953. Today there are 18 SFCs in country which exist in almost in every state and union territory of the country. Each SFC has its own Managing Director, Executive Director, Board of Directors and Management team to take care activities independently.

KARNATAKA STATE FINANCE CORPORATION(KSFC)

State finance corporation in Karnataka is called Karnataka state finance corporation

Objectives

- To cater to financial requirements of Small scale units
- To extend medium and long-term credits to units which fall outside the purview of Industrial Finance Corporation and public-sector banks

Activities/Function of SFCs

- To promote self-employment for professionally qualified men and women entrepreneurs interested in starting their own project
- Financial assistance for expansion, modernization and mechanization in the existing set up
- Financial assistance for rehabilitation of sick units
- To provide term loans for purchase of land, building, machinery and other facilities
- To provide financial assistance for transport vehicle and tourism related activities
- To arrange EDP and seminars for upcoming young industrialists
- To provide financial assistance for quality improvement and environmental control needs

Problems of SFCs

- Since SFCs are stated by respective state Governments, the usual problems of state bureaucracy of procedures, delays, castism and favoritism do occur
- In the state offices, problems of corruption and other malpractices continue to bother applicants
- In case of repayments very strict procedure are followed and units are sealed

5.12.4. KARNATAKA INDUSTRIAL AREAS DEVELOPMENT BOARD (KIADB)

It is wholly owned infrastructure agency of Government of Karnataka, set up under Karnataka Industrial Areas Development Act of 1996. This Board function as per statutory provisions, rules and regulations enacted under them. Board of members meet regularly to take decisions and monitor functions.

KIADB holds pride in being the first Government organization in Karnataka to obtain ISO 9001 certification in the year 1997. Now KIADB is following ISO 9001:2000 module covering its functions of land acquisition, development and allotment functions in Bangalore urban and rural areas.

Objectives

- Promote rapidly and orderly development of industries in the state.
- Assist in implementation of policies of Government within the purview of KIAD act
- Facilitate for establishing infrastructure projects
- Function on corporate lines "no profit, no loss"

Functions

- Acquire land and form industrial areas
- Provide all infrastructure to such industrial areas
- Acquire land for single unit complexes
- Acquire land for Government agencies for their schemes and infrastructure projects

Few prominent industrial areas: Peenya, Electronic city, Export Promotion Industrial park (EPIP) in Bangalore, Hebbal in Mysore, Baikampady in Mangalore, Tarihal in Dharwar, Kakati in Belgaum and Auto complex in Shimoga. Apart from this, it has envisaged several innovative projects up its sleeve like Agro-Tech parks, Apparel Park, Auto parks, Hardware Parks, Bio–Tech park, EPIPs, special Economic Zones, etc.

Some projects of KIADB executed

- Acquisition of about 4316.25 acres of lands for Bangalore International Airport Ltd.
- Acquisition of about 1850 acres of lands for Harbor at Tadri in Uttar Kannada district
- Acquisition of about 1958 acres of land for M/s MRPL at Mangalore and rehabilitation of 610 displaced families with modern infrastructure
- Acquiring and developing of about 430 acres of land for M/s Toyota in Bidadi at Bangalore District
- Other industrial areas are also supported with secondary infrastructure for both state owned and private agencies like Public transport facilities and medical facilities, Telephones, post & Telegraphs, Schools and industrial training facilities, Police stations/out posts and Fire Stations, also Health clubs and Cinema Theaters

NON -FINANCIAL ASSISTANCE INSTITUTES

5.12.5 SMALL INDUSTRIES SERVICE INSTITUTES (SISI):

It was set up by Ministry of Industry, Government of India. It is under the [illegible] Development Commissioner SSI (DCSSI). There are 58 SISIs all over country [illegible] one in each State Capital.

Nature of support:

Entrepreneurship development, Consultancy and training

Objectives:

- To provide consultancy and training to small entrepreneurs-both existing prospective
- To serve as an interface between Central and State Governments
- To initiate entrepreneurial promotion programs

Functions:

- To serve as interface between central and state Governments
- To render technical support services
- To conduct EDP
- To initiate promotional programmes
- Collect Trade and market information and share it with entrepreneurs
- Conduct practical training programmes on various trades
- Arrange displays of various items of big industries to assist SSIs to take mandy of the same and for supplying the same to industries
- Co-ordinating the activities of ancillary industries in state

5.12.6 DISTRICT INDUSTRIES CENTRE'S (DIC)/SINGLE WINDOW CONCEPT

It was established in May 1978 to cater to needs of small units. The main fu of DIC is to act as chief coordinator or multi-functional agencies in respect of v Government departments and other agencies. There are about 400 DICs in India

Nature of support:

Information and consultancy services, industrial inputs.

Objectives:

- To effectively promote cottage and SSI in rural areas and small towns
- To act as single window agency to help the entrepreneur with all informatio one roof
- To serve as integrated administrative frame work at district level for development

Functions:

- To conduct industrial potential surveys keeping in view the availability of resources in terms of material and human skill, infrastructure, demand for product, etc.
- To prepare techno-economic surveys and identify product lines and then to provide investment advice to entrepreneurs
- To prepare an action plan to effectively implement the schemes identified
- To guide entrepreneurs in matters relating to selecting the most appropriate machinery and equipment, sources of its supply and procedure for procuring imported machinery if needed, assessing requirements for raw materials, etc.
- To appraise the worthiness of the various proposals received from entrepreneurs
- To assist the entrepreneurs in marketing their products and assess the possibilities of ancillary station and export promotion of their products
- To undertake product development work appropriate to small industries
- To conduct artisan training programmes

5.12.7 NATIONAL SMALL INDUSTRIES CORPORATION (NSIC):

It is an enterprise under the Union Ministry of Industries, was set up in 1955 to promote aid and foster the growth of small scale industries in the country. NSIC provides a wide range of services, predominantly promotional in character to small scale industries.

Its main functions are:

- To provide machinery and hire-purchase scheme to small scale industries
- To provide required leasing facility
- To help in export marketing of the products of small scale industries
- To participate in bulk purchase programme of the Government
- To develop prototype of machines and equipment's, to pass on to small scale industries for commercial production
- To distribute basic raw material among small scale industries through raw material depots
- To help in development and upgradation of technology and implementation of modernization programmes of small scale industries
- To impart training in various industrial trades

5.12.8 TECHNICAL CONSULTANCY SERVICE ORGANIZATION OF KARNATAKA (TECSOK):

This organization is highly useful to entrepreneurs in providing many services and are found in almost all the states. It was established in 1976 by Government of Karnataka. Its office is in Nrupatunga Road, Bangalore. It helps entrepreneur in preparation of feasible reports at a subsidized cost.

Nature of support:

Multi-disciplinary: Technical, Industrial and Management Consultancy.

Objectives:

- To provide reliable consultancy support for entrepreneurs to start up self-employment ventures in Karnataka
- To provide consultancy services to various departments and agencies of state and central Governments

Functions:

- Identification of project ideas and selection of investment opportunities
- Selection of suitable locations for setting up industrial units
- Conducting market surveys, industrial potential surveys
- Preparation of detailed techno -economic feasibility report/detailed project report
- Energy audit and conservation
- Modernization studies
- Dissemination of information on industrial policies and procedures, central as well as state government
- Assistance to government in providing information about new policies, programs and schemes
- Assist in obtaining necessary licenses and clearances

5.13 BUSINESS PLAN

Business plan is a written document prepared by entrepreneur that describes all the relevant external and internal elements involved in starting new venture. It is an integration of functional plans such as marketing, finance, manufacturing and human resource plan. A business plan is a blue print of step by step process that would be followed to convert business idea into successful business venture

5.13.1 OBJECTIVE OR IMPORTANCE OF BUSINESS PLAN

- To give direction to the vision formulated by the entrepreneur
- To objectively evaluate the prospectus of business
- To monitor the progress after implementing business plan
- To persuade others to join business
- To seek loans from financial institutions
- To visualize concept in terms of market availability, organizational, operational, and financial feasibility
- To guide entrepreneur in actual implementation of plan
- To identify actual strength and weakness of plan
- To identify challenges in terms of opportunities and threats from the external

markets.

- To clarify ideas and identify gaps in management information about their business. competitors and market.
- To identify the resources that would be required to implement the plan
- To document ownership arrangements. future prospectus and projected growth of the business venture.

5.13.2 BUSINESS PLAN PROCESS

Business Plan Process consists of following steps

1. Idea generation
2. Environmental scanning
3. Feasibility analysis
4. Project report preparation
5. Evaluation. control and review

1. Idea generation:

It is the first step in the business planning process. This step differentiates entrepreneur from usual business. An entrepreneur may come up with new business idea or may bring in value addition to existing product in the market.

Sources of new idea for entrepreneurs are :

- Consumers/ customers
- Existing companies
- Research and development
- Employees
- Dealers, retailers

2. Environmental scanning:

Once the entrepreneur is through the idea generation stage, next entrepreneur is required to conduct environmental scanning which includes analysing external and internal environment that affects business idea

1. External environment comprises of

a) Socio cultural appraisal: it gives brief overview about the culture and tradition existing in society. It is comprised of values and beliefs of people which determines the acceptance of product by customer in the market.

b) Technological appraisal: it assesses various technological options available to convert an idea to product. It also provides a brief overview about technological updating.

c) Economic appraisal: it assesses the status of the society in terms of economic development, per capita income, national income, consumption pattern in the business.

d) Demographic appraisal: it assesses the population pattern of given ... Which includes sex. age profile. distribution etc.

e) Economic appraisal: it assesses the status of the society in terms ... development, per capita income, national income, consumption ... business.

f) Demographic appraisal: it assesses the population pattern of given ... Which includes sex. age profile. distribution etc.

g) Government appraisal: it assesses the various legislation, policies ... formulated for particular industry. Flexibility of these rues ... entrepreneur in terms of opening venture in particular area.

Internal environment:

a) Raw material: it refers to in terms of availability of raw material ... process of production. If the material availability is at distance place ... expensive then entrepreneur should give second thought to the same.

b) Production/ operation: it assesses the availability of various ... equipment's, tools and techniques that would be required for production.

c) Finance: it studies total requirement of finance in terms of start-up ... expenses, running expenses etc.

d) Market: refers to study on potential customer and target customers in ...

e) Human resource: refers to demand and supply of required human ... and estimation of expenses to be incurred on human resource.

3. Feasibility analysis:

It refers to conducting detailed analysis in relation to every aspect relevant ... and determining credibility of business.

a) Market analysis: is conducted to estimate the demand and market share ... product and service in future. Demand and market analysis is based on ... consumption pattern, availability of substitute goods and services etc.

b) Technical and operational analysis: is to assess operational ability ... business enterprise. Technical or operational analysis collects data on ... parameters like Material availability, Material requirement planning, Plant ... Plant capacity, Machinery and equipment

c) Marketing plan:It lays down the strategies of marketing which can ... of business plan. Strategies are in terms of marketing mix which includes ... price, place, promotion) which determines the potential demand of ... product in the market.

d) Production plan / operational plan: production plan is drafted for ... sector where as operation plan is designed for business into ... comprises of strategies on parameters such as location layout, cost ... material, human resource etc.

Organizational plan: defines type of ownership pattern in company, sole trading concern, family business, private or public limited company etc.

Financial plan: financial plan indicates the requirement of proposed business enterprise. Which includes fund flow, cash flow statement, breakeven point, projected ratio, projected balance sheet.

Project report preparation: project report is a written document that describes step by p strategies involved in starting and running business.

Evaluation, control and review: as company operates in dynamic environment company s to monitor and review strategies and policies to stay in line with competition existing market

14 MARKET PLAN

Market plan refers to plan that describes market condition and strategy related to how oducts and services will be distributed, priced and promoted in market.

Industry analysis prior to preparation of market plan entrepreneur are required to conduct dustry analysis section of the business plan. Industry analysis provides information bout national and local market that affection marketing operation of company. Industry alysis also involves collecting information about competitors which is available in form f secondary data by newspapers, article, websites, catalogues, promotions, interview with istributors, customers etc

.15 STEPS IN MARKET RESEARCH

Defining the purpose or objective: it refers to entrepreneur should be clear nature of nformation required by the business, sources through which required data will be collected, whether required data will be from primary or secondary source of information.

Gathering data from secondary sources: secondary source of information refers to data vailable about competitor's strategy and their position in the market. Required information n competitors is available through magazines, new papers, libraries etc

Gathering information from primary source: primary data required for market research s collected through methods such as observation, networking, interviewing, focus group, exhibition etc.

Analysing and interpreting results: results should be evaluated and interpreted depending on the objective of research process.

Summarizing results will provide in preliminary insights about competitor's market position and their image in competitive environment.

5.16 CHARACTERISTICS/ IMPORTANCE OF MARKET PLAN

- It should provide strategy for accomplishing the company mission and goal.
- It must provide for the use of existing resources and allocation of all equipment, financial resources, human resources in company.

- It should provide for continuity so that each annual marketing plan can successfully meet long term goals and objectives of company.
- It should be simple and specific in nature so as to provide appropriate road may in terms of planning market strategy for company.
- It should focus on criteria to be evaluated to assess market success of the company.

5.17 STEPS IN PREPARING MARKET PLAN

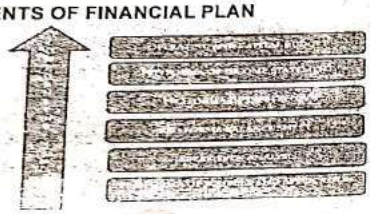
1. Defining business situation: It refers to understand past and present business achievements of new venture. It gives basic insight about scenario persisting in market, response of customers to new venture in market, and helps in predicting customer acceptance of company product in market
2. Defining target market: Target market refers to group of potential customers towards which venture aims its market plan. Knowledge of target market will provide basis for determining appropriate market action strategy to meet needs of customers. Target market also includes market segmentation which involves process of dividing market into definable and measurable groups for purpose of targeting market strategy.
3. Considering strength and weakness: Strength of business refers to core areas which company is specialized in which may be abundance experience of company in similar area of business and weakness may be in terms of production capability, or layout which permits limited space for equipment and operation
4. Establishing goals and objectives: Marketing goals of the company should be clear and specific in nature as it has to clearly indicate about nature of product, target customers, sales promotion, advertising support etc.
5. Defining market strategy and action program: It refers to specific activities outlined to meet the venture, business plan objectives and goals.
   a. Product and service: indicates description of product or service to be marketed in the new venture.
   b. Pricing: refers to price to be charged for product in market before which company is required to consider various aspects such as cost, margin, competition etc.
   c. Distribution: refers to means through which product will be made available to customer in market which involves decision relating to nature of product, distribution channel, middlemen etc.
   d. Promotion: refers to various channels through which entrepreneur will advertise company product to customers in market.
6. Marketing strategy: It involves understanding the nature of product and accordingly planning in for marketing product. Entrepreneur may market consumer product directly to customers while manufacturing products are to be sold to business than customers in market. Dell computers markets its products both to customers as well as business people.

7. Budgeting marketing strategy: After drafting marketing plan entrepreneur is required to estimate total expenses to be incurred in process of implementing market plan. Expense of marketing plan should be in line with planned expense of entrepreneur.
8. Implementation of market plan: Market plan should be implemented in the company, should be informed to the workforce involved in marketing activity, it acts as guiding element to direct on strategies which will make marketing process effective.
9. Marketing progress of marketing actions: Marketing of plan involves tracking specific results of marketing effort. Sales data of product, data gathered by market survey are few methods of monitoring progress of market plan

5.18 FINANCIAL PLAN

It studies total requirement of finance in terms of start-up expenses, fixed expenses, running expenses etc. financial plan indicates the requirement of proposed business enterprise. Which includes fund flow, cash flow statement, breakeven point, projected ratio, projected balance sheet.

5.18.1 COMPONENTS OF FINANCIAL PLAN



1) Operating and capital budget: Before developing pro forma income statement, entrepreneur should prepare operating and capital budgets. If entrepreneur is running sole trading concern then he is responsible for budgeting decision and if it is partnership or other form of legal concern then budgeting decisions are to be taken by assigned member of business.
2) Pro forma of income statement: refers to projected net profit calculated from projected revenues minus projected costs and expenses. It should comprise of sales on monthly basis, insight on operating expenses, salaries and wages should highlight on total number of employees employed in company.
3) Pro forma of cash flow: refers to projected cash available calculated from projected cash accumulation minus projected cash dismemberment. It is result of difference between actual cash receipts and cash payments. Cash flow takes place in company only when payments are made or received.
4) Pro forma of balance sheet: summarizes the projected assets, liabilities, and net worth of new venture. Balance sheet represents the position of the business at end of year. Assets represent the items that are owned or available to be used in venture operation.

5) Break even analysis: entrepreneur in initial stage is required to know when may be achieved which will help him understand financial potential of business. BEA is useful technique to analyse how many units have been sold of sales where venture neither makes profit nor loss.
6) Pro forma for sources and application of funds: summarizes projected fund available to the venture and how these funds will be distributed.

5.19 THE PROJECT REPORTS

The project report is a document, which gives an account of the project ascertain the prospects of the proposed plan/activity. The project report contains information about. Land & building required, Manufacturing Capacity per Manufacturing Process, Machinery & equipment along with their prices and Requirements of raw materials, Power & Water required, Manpower needs, Cost of the project and production, Financial analyses & economic viability of the

5.19.1 FEASIBILITY

A feasibility report is an investment proposal base on certain information and data appraising the project. This type of feasibility study may be required by the institutions, project sponsor, project owner.

The feasibility report enables the project holder to know the inputs required rightly prepared confirms to the convictions that he is proceeding in the right direction other words, a project needs to be fully defined in order to provide terms of reference the management of the project.

5.19.2 COMPONENTS OF FEASIBILITY STUDY

Project feasibility analysis is carried out to ensure viability of project. The project feasibility study is

1. Market feasibility
2. Technical feasibility
3. Financial feasibility
4. Economic feasibility
5. Ecological feasibility

Market feasibility

Market feasibility is concerned with two aspects the aggregate demand for the product/service, the market share of the project under consideration. For this analysis requires variety of information and appropriate forecasting methods.

The kind of information required is

- Consumption trends in the past and the present consumption level
- Past and present supply position

- Production possibilities and constraints
- Imports and exports
- Structure of competition
- Cost structure, Elasticity of demand
- Consumer behavior, intentions, motivations, attitudes, preferences and requirements

Technical Analysis

Technical analysis seeks to determine whether prerequisites for successful commissioning of the project have been considered and reasonably good choices have been made with respect to location, size, and so on.

The important questions raised in technical analysis are:

- Has the availability if raw material, power, and other inputs been established?
- Is the selected scale of operation optimal?
- Is the production process chosen suitable?
- Are the equipment and machines chosen appropriate?

Financial Analysis

Financial analysis is necessary as ascertain whether the propose project is financially viable in the sense of being able to meet the burden of servicing dept and whether the propose project will satisfy the return expectations of those who provide the capital. The aspects to be looked into while conducting financial appraisal are as follows.

- Investment outlay and cost of project
- Means of financing.
- Project profitability
- Break-even point
- Cash shows of the project
- Level of risk

Economic/Social Cost-benefit Analysis

This is concerned with judging a project from the larger social point of view, where in the focus if on social costs and benefits of a project, which may often be different from its monitory costs and benefits.

The questions to be answered in social cost-benefit analysis are as follows

- What are the direct economic benefits and costs of the project measured in terms of shadow (efficiency) prices and not in terms of market prices?
- What would be the impact of the project on the distribution of income in the society?
- What would be the impact of the project on the level of savings and investment in the society?
- What would be the contribution of the project towards the fulfillment of certain like self-sufficiency, employment and social order?

Ecological Analysis

Today, environmental concerns assured a great deal of significance and hence ecological analysis should be done, particulars for project which have significant ecological implications like power plants and irrigation schemes and for environmental polluting industries like chemicals, leather processing etc.

The key questions to be answered in ecological analysis are as follows

- What is the likely damage caused by the project to the environment?
- What is the cost of restoration measures required to ensure that the damage to the environment is contained within acceptable?

5.20 SIGNIFICANCE OF PROJECT REPORT

A project report or a business plan is a written statement of what an entrepreneur proposes to take up.

- Project report is like a road map it describes the direction the enterprise is going in, what its goals are, where it wants to be, and how it is going to get there.
- It enables the entrepreneur to know that he is proceeding in the right direction.
- The preparation of project report is beneficial for those small scale enterprises which apply for financial assistance from the financial institutions and commercial banks.
- Based on this project report the financial institutes make appraisal and decide whether financial assistance should be given or not.

5.21 CONTENTS OF A PROJECT REPORT

Having gone through the significance of project report, there is no substitute for a well-prepared business plan or project report and also there are no shortcuts to preparing it. The more concrete and complete the business plan, the more likely it is to earn the respect of outsiders and their support in making and running an enterprise. Therefore, the project report needs to be prepared with great care and consideration.

A good project report should contain the following contents:

(1) **General information:** Information on product profile and product details.

(2) **Promoter:** His/her educational qualification, work experience, project related experience

(3) **Location:** exact location of the project, lease or freehold, location advantages.

(4) **Land and building:** land area, construction area, type of construction, cost of construction, detailed plan and estimate along with plant layout.

(5) **Plant and machinery:** Details of machinery required, capacity, suppliers, cost, various alternatives available, cost of miscellaneous assets

(6) **Production process:** Description of production process, process chart, production programme.

(7) **Utilities:** Water, power, steam, compressed air requirements, cost estimates sources of utilities.

(8) **Transport and communication:** Mode, possibility of getting costs.

(9) **Raw material:** List of raw material required by quality and quantity, sources of procurement, cost of raw material, tie-up arrangements, if any for procurement of raw material, alternative raw material, if any.

(10) **Man power:** Man power requirement by skilled and semi-skilled, sources of manpower supply, cost of procurement, requirement for training and its cost.

(11) **Products:** Product mix, estimated sales distribution channels, competitions and their capacities, product standard, input-output ratio, product substitute.

(12) **Market:** End-users of product, distribution of market as local, national, international, trade practices, sales promotion devices, proposed market research.

(13) **Requirement of working capital:** Working capital required, sources of working capital, need for collateral security, nature and extent of credit facilities offered and available.

(14) **Requirement of funds:** Break-up project cost in terms of costs of land, building machinery, miscellaneous assets, preliminary expenses, contingencies and margin money for working capital, arrangements for meeting the cost of setting up of the project.

(15) **Cost of production and profitability of first ten years.**

(16) **Break-even analysis.**

(17) **Schedule of implementation.**

5.22 FORMULATION OF PROJECT REPORT

Project formulation divides the process of project development into eight distinct and sequential stages as below:

(1) General Information

The information of general nature given in the project report includes the following:

- *Bio-data of promoter*: Name and address, qualifications, experience and other capabilities of the entrepreneur. Similar information of each partner if any.
- *Industry profile*: A reference analysis of industry to which the project belongs,
- *Constitution and organization*: The constitution and organization structure of the enterprise; in case of partnership firm its registration with registrar of firms, certification from the directorate of industries /district industry center.
- *Product details*: Product utility, product range, product design, advantage to be offered by the product over its substitutes if any.

(2) Project Description

- *Site:* Location of the unit; owned, rented or leasehold land; industrial area; no objection certificate from municipal authorities if the enterprise location falls in the residential area.
- *Raw material*: Requirement of raw material, whether inland or imported, sources of raw material supply.

- *Skilled labor*: Availability of skilled labor in the area i.e., arrangements for ... laborer's in various skills.
- *Pollution control*: The aspects like scope of dumps, sewage system, ... treatment plant, infiltration facility etc., should be mentioned.
- *Communication and transportation facility*: The availability of ... facilities, e.g., telephone, fax, telex, internet etc., should be indicated.
- *Production process*: A mention should be made for process involved in ... and period of conversion from raw material into finished goods.
- *Machinery and equipment*: A complete list of machines and equipment's ... indicating their size, type, cost and sources of their supply should be ... the project report.
- *Capacity of the plant*: The installed licensed capacity of the plant along ... shifts should also be mentioned in the project report.
- *Technology selected*: The selection of technology, arrangements made for ... it should be mentioned in the business plan.
- *Other common facilities*: Availability of common facilities like machine ... welding shops and electrical repair shops etc. should be stated in the project ...
- *Research and development*: A mention should be made in the project ... regarding proposed research and development activities to be undertaken ...

(3) Market Potential

- *Demand and supply position*: State the total expected demand for the ... present supply position, what is the gap between demand and supply and how ... gap will fill up by the proposed unit.
- *Expected price*: Expected price of the product to be realized should also be ...
- *Marketing strategy*: Arrangements made for selling the product should be ... stated in the project report.

(4) Capital Costs and Sources of Finance

The sources should indicate the owner's funds together with funds raised from ... institutions and banks.

(5) Assessment of Working Capital

It is preferred to prepare working capital requirements in the prescribed format ... by limits of requirement. It will reduce the objections from banker's side.

(6) Other Financial Aspects

To adjudge the profitability of the project to be set up, a projected profit and ... indicating likely sales revenue, cost of production, allied cost and profit should be ... A projected balance sheet and cash flow statement should also be prepared to ... financial position and requirements at various stages of the project.

omical and Social Variables

enterprise has social responsibility. In view of the social responsibility of business, ement costs, i.e., the costs for controlling the environmental damage should be the project

ject Implementation

y entrepreneur should draw an implementation scheme or a time-table for his to the timely completion of all activities involved in setting up an enterprise.

PLANNING COMMISSION GUIDELINES:

process investment proposals and arrive at investment decisions, the Planning mission *of* India has also issued some guidelines *for* preparing/formulating realistic trial projects. So far as feasibility report is concerned, it lies in between the project ulating stage and the appraisal and sanction stage. The project formulation stage lves the identification *of* investment options by the enterprise and in consultation with Administrative Ministry, the Planning Commission and other concerned authorities.

General information:

The feasibility report should include an analysis *of* the industry to which the project longs. It should deal with the past performance *of* the industry. The description *of* the type industry should also be given, i.e., the priority of the industry, increase in production, le *of* the public sector, allocation *of* investment of funds, choice of technique, etc. This hould also contain information about the enterprise submitting the feasibility report.

2. Preliminary analysis of alternatives:

This should contain Present data on the gap between demand and supply for the outputs which are to be produced, data on the capacity that would be available, complete list of all existing plants in the industry, giving their capacity and level of production, list of all projects for which letters of licenses have been issued and a list of proposed projects. the location of the project as well as its implications, an account of the foreign exchange requirement, the profitability of different options should be given, rate of return on investment should be calculated and presented in the report

3. Project description:

The feasibility report should provide a brief description of the technology/process chosen for the project. The report should contain a list of important items of capital equipment and the list of the operational requirements of the plant, requirements of water and power, requirements of personnel, organizational structure envisaged, transport costs, activity wise phasing of construction and factors affecting it.

4. Marketing plan:

It should contain the following items: Data on the marketing plan, demand and prospective supply in each of the areas to be served.

5. Capital Requirements and Costs:

The estimates should be reasonably complete and properly estimated. Information on all items of costs should be carefully collected and presented.

6. Operating Requirements and Costs:

Operating costs are essentially those costs which are incurred after the commencement of commercial production. Information about all items of operating cost should be collected; operating costs relate to the cost of raw materials and intermediates, fuel, utilities, labor, repair and maintenance, selling expenses and other expenses.

7. Financial Analysis

The purpose of this analysis is to present some measures to assess the financial viability of the project. A proforma Balance Sheet for the project data should be presented. Depreciation should be allowed for based on specified by the Bureau of Public Enterprises. Foreign exchange requirements should be cleared by the Department of Economic Affairs. The feasibility report should consider income-tax rebates for priority industries, incentives for backward areas, accelerated depreciation, etc. The sensitivity analysis should also be presented. The report must analyze the sensitivity of the rate of return of change in the level and pattern of product prices.

8. Economic Analysis:

Social profitability analysis needs some adjustment in the data relating to the costs and returns to the enterprise. One important type of investment involves a correction in input and costs, to reflect the true value of foreign exchange, labor and capital. The enterprise should try to assess the impact of its operations on foreign trade. Indirect costs and benefits should also be included in the report. If they cannot be quantified, they should be analyzed and their importance emphasized.

5.24 MEANING OF INTERNATIONAL ENTREPRENEURSHIP

It is the process of an entrepreneur conducting business activity across the national boundaries. It may consist of exporting, licensing, opening sales office in another country etc. International entrepreneurship is defined as development of international new ventures or start ups that from their inception engage in international business, thus viewing their operation domain as international from the initial stages of international operations.

5.24.1 IMPORTANCE OF INTERNATIONAL ENTREPRENEURSHIP

International entrepreneurship is beneficial as sales of company is declining in domestic market, they can sell products in international market considering demand for product in other country market customers.

- Entrepreneur can sell their products in foreign market which have reached the maturity stage of their life cycle in domestic markets and earn profit by their sales.
- Companies which are incurring high level of fixed costs can lower their manufacturing costs by spreading these fixed costs over long number of units by selling their products in global market.

- Entrepreneur can improve their entrepreneurial competitiveness and enhance reputation.
- Entrepreneur in process of satisfying foreign customers have to produce product as per their quality expectation by which entrepreneur will not only produce quality product in international market but also in national market.
- Internationalization of business will teach entrepreneurs how to cultivate habit of customer relation management (CRM)
- Being global will make the entrepreneur sensitive towards their customers–domestic, adopt more respectful attitude towards foreign habits and customers.
- Entrepreneurs can hire motivated, multi lingual employees, learn constantly about the foreign markets. They will think globally and start developing an outlook from a global prospective.

5.24.2 IMPORTANCE OF INTERNATIONAL ENTREPRENEURSHIP TO FIRM

- As it Increases sales and profit : when the entrepreneurs are not able to earn profit or demand for their product decreases in local market they can sell their products in foreign market where life cycle of product is in favourable condition. E.g. Apple earned more profits from international business than in local market US in the year 1994. ($ 390 million foreign market / $ 310 in Indian market .
- Lower manufacturing cost : if the company manufacturing cost increases by manufacturing product in home country, than company can opt in for production process in host country, on the contrary if the company is in no profit or no loss situation than company can choose in any option. E.g Mc Donalds
- Advantage of cheap labour : quantity and quality of labour is one of the major challenge for every business, if the labour is cheap in foreign countries than company can outsource required labour if organization is into foreign operations. E.g increasing cost of labour in china has forced companies to search in for other options for outsourcing company activity to other countries were cost of labour is less.
- Utilization of talent and managerial competence : when business are not able to get required talented work force in country, they can get the activity outsourced or hire host country employee which has given birth to concept of expatriation.
- Growth opportunity : entrepreneurs whose core business strategy is expansion and diversification of business, international business is one of the primary platform to achieve these objectives.
- Expansion of domestic market : international business causes domestic market to expand beyond national boundaries. When the domestic market has bee fully tapped than company can go in for expansion of business to market their products in international market. E.g Sony

- Globalization of customers : it refers to when customers in country prefer foreign brand products than domestic companies have to go in for internationalization of business to keep in pace with competition to attract customers. Take example begin to operate in international market after entry of foreign competitors in market like ford.
- Globalization of competitors : international business increases the opportunities only for the survival and growth but also motivates companies to face competition from global entrants in market, which in turn leads to growth of market, to global scale efficiencies etc.
- Pay offs of international business : international business improves image of company in domestic market and attracts more customers in domestic market internationalization of business. E.g Ranbaxy

5.25 ENTREPRENEURIAL ENTRY INTO NEW BUSINESS

Exporting: means selling goods made in one country to another country normally involves the sale and shipping of products manufactured in one country to customer located in another country.

- Direct exporting: implies where company takes full responsibility for making goods available in the target market by selling directly to end users normally through its own agents.
- Indirect exporting: when the exporting company does not possess the infrastructure to involve itself in direct exporting, indirect exporting takes place when the export company sells its to intermediaries who in turn sell the same products to the end users in foreign markets.

Licensing: involves an entrepreneur who is a manufacturer (license) giving another manufacturer (licensor) the right to use patent, trade mark, technology, production process or product in return for the payment of loyalty.

Turn key projects: Turnkey refers to something that is ready for immediate use generally used in the sale or supply of goods or services. It is a contract under which a firm agrees to fully design, construct and equip a manufacturing/ business/ service facility and then project over to the purchaser when it is ready for operation for a remuneration.

Management contract : It is an arrangement under which operational control of an enterprise is vested by contract in a separate enterprise which performs the necessary management functions in return for a fee. Management contracts involve not just selling a method of doing things (as with franchising or licensing) but also doing them. A management contract involves a wide range of functions, such as technical operation of a production system, management of personnel, accounting, marketing services and training.

Foreign direct investment (FDI) is direct investment into one country by a company in production located in another country either by buying a company in the country or by expanding operations of an existing business in the country

Minority interest : a company having interest or ownership of less then 50 percent in another company is known as minority interest/ A significant but non- controlling ownership of less than 50% of a companys voting shares by either an investor or another company.

Majority interest : majority interest is an ownership interest greater than fifty percent (50%) of the voting interest in a business enterprise.

Joint venture (JV) is a business agreement in which parties agree to develop, for a finite time, a new entity and new assets by contributing equity. They exercise control over the enterprise and consequently share revenues, expenses and assets. A joint venture takes place when two parties come together to take on one project. In a joint venture, both parties are equally invested in the project in terms of money, time, and effort to build on the original concept.

Mergers : The combining of two or more companies, generally by offering the stockholders of one company securities in the acquiring company in exchange for the surrender of their stock / Mergers and acquisitions refers to the aspect of corporate strategy, corporate finance and management dealing with the buying, selling, dividing and combining of different companies and similar entities that can help an enterprise grow rapidly in its sector.

Horizontal merger : Horizontal merger occurs when a firm is being taken over by, or merged with, another firm which is in the same industry and in the same stage of production as the merged firm, e.g. a car manufacturer merging with another car manufacturer / A horizontal merger is when two companies competing in the same market merge or join together. E.G amalgamation of Daimler-Benz and Chrysler

Vertical merger : is the combination of two or more firms in successive stages of production that often involve buyer and seller relationship. This form of merger stabilize supply and production and offer more control of these critical areas. (merger between Mc Donalds and Philips petroleum)

Product extension : merger occurs when acquiring and acquired company have related production or distribution activities but do not have products that compete directly with each other (merger between western publishing (childrens books) and Mattel (toy company).

Product extension merger is a combination of two firms producing the same product but selling them in different geographic market. Major advantage of these mergers is that firms can economically combine its management skills, production and marketing with acquired firms. (The acquisition of Mobilink Telecom Inc. by Broadcom is a example of product extension merger) (Broadcom deals in the manufacturing Bluetooth personal area network hardware systems and chips for IEEE 802.11b wireless LAN. Mobilink Telecom Inc deals in the manufacturing of product designs meant for handsets that are equipped with the Global System for Mobile Communications technology)

Market extension merger : A market extension merger takes place between two companies that deal in the same products but in separate markets. The main purpose of the market extension merger is to make sure that the merging companies can get access to a bigger market and that ensures a bigger client base. (Acquisition of Eagle Bancshares Inc by the RBC Centura)

Diversified activity merger : this is a conglomerate merger involving consolidation of two unrelated firms. (Philip Morriss acquisition of Miller Brewing)

5.26 BARRIERS TO INTERNATIONAL TRADE

Attitude of entrepreneur : when an entrepreneur has negative mindset that foreign market is unknown to him and he might find it difficult to set up his business in new country will prove to be a major barrier for international trade.

Lack of information : as entrepreneur is new entrant in international market he is unaware about the market conditions in host country and taste and preference of customers which may lead to issues in terms of acceptance and locating product in market.

Lack of network influences : network with established business companies makes it easy for the entrepreneur in new market but if the entrepreneur has no contacts in foreign country then it will be difficult for entrepreneur from initial stage of getting required permission to establishing business in country.

Financing problems : as international business involves huge risk financial institutions may be reluctant in terms of providing required finance to entrepreneurs.

Tariff barriers : tariff means duty levied by the government on imports. Imposing tariff raises the price of imported goods making them less attractive to consumers and protects makers of comparable domestic products and services.

Non tariff barriers : are the obstacles to imports other than tariffs such as testing, certification, or bureaucratic hurdles that have effect of restricting imports. These are administrative measures that are imposed by a domestic government to discriminate against foreign goods and in favour of home goods.

Technical barriers : basically refers to before a countrys goods enters into foreign market it has to go through certain test for authentication. In US before food products from others is marketed in US it will be tested for checking bacteria content in food item for safety of general public, which is good for safety of host country but may prove to be a major barrier to home country exporting product.

Political barrier : in few country their exist abundant opportunity for business but political scenario in country will be instable such as kidnappings, bombings, violent against business and employees which proves to be major question mark in terms of future success of business.

Human resource : presence of labour unions, hostile management unions relations, strike, increase coat of labour in foreign country may prove it difficult for entrepreneur to establish business in foreign market.

Cultural barriers : as entrepreneur is new entrant in host country he may not be aware about language, education, tradition, religion, values of citizens which will make it difficult for the entrepreneur to understand mindset, taste and preference of customer in market.

5.27 EXPORT

An export is a function of international trade whereby goods produced in one country are shipped to another country for future sale or trade. The sale of such goods adds to the producing nation's gross output.

Exports are one of the oldest forms of economic transfer and occur on a large scale between nations that have fewer restrictions on trade, such as tariffs or subsidies. Most of the largest companies operating in advanced economies derive a substantial portion of their annual revenues from exports to other countries. The ability to export goods helps an economy to grow. One of the core functions of diplomacy and foreign policy within governments is to foster economic trade for the benefit of all trading parties.

Exports are a crucial component of a country's economy. Exports facilitate international trade and stimulate domestic economic activity by creating employment, production, and revenues. As of 2016, the world's largest exporting countries in terms of dollars are China, the United States, Germany, Japan and the Netherlands. China has exports of approximately $2.1 trillion, primarily electronic equipment and machinery. The United States exports approximately $1.5 trillion, primarily capital goods. Germany has exports of approximately $1.3 trillion, primarily motor vehicles. Japan has exports of approximately $645 billion, also primarily motor vehicles. Finally, the Netherlands has exports of approximately $570 billion, primarily machinery and chemicals.

5.27.1 ADVANTAGES OF EXPORTING FOR COMPANIES

Companies export products and services for a variety of reasons. Exporting can increase sales and profits if they reach new markets and may even present an opportunity to capture significant global market share. Companies that export spread business risk by diversifying into multiple markets. Exporting into foreign markets can often reduce per-unit costs by expanding operations to meet increased demand. Finally, companies that export into foreign markets gain new knowledge and experience that may allow the discovery of new technologies, marketing practices and insights into foreign competitors.

5.27.2 CHALLENGES OF EXPORTING

Companies that export are presented with a unique set of challenges. Extra cost likely to be realized because companies must allocate considerable resources to research foreign markets and modifying products to meet local demand and regulations. Companies that export are typically exposed to a higher degree of financial risk. Payment collection methods such as open-account, letter of credit, prepayment and consignment are inherently more complex and take longer to process than payments from domestic customers.

5.28 FOREIGN DIRECT INVESTMENT - FDI'

Foreign direct investment (FDI) is an investment made by a company or individual in one country in business interests in another country, in the form of either establishing business operations or acquiring business assets in the other country, such as ownership or controlling interest in a foreign company. Foreign direct investments are distinguished from portfolio investments in which an investor merely purchases equities of foreign companies. The key feature of foreign direct investment is that it is an investment that establishes either effective control of, or at least substantial influence over, the decision making of a foreign business.

5.28.1 METHODS OF FOREIGN DIRECT INVESTMENT

Foreign direct investments can be made in a variety of ways, including the opening of a subsidiary or associate company in a foreign country, acquiring a controlling interest in an existing foreign company, or by means of a merger or joint venture with a foreign company.

The threshold for a foreign direct investment that establishes a controlling interest, per guidelines established by the Organization of Economic Cooperation and Development (OECD), is a minimum 10% ownership stake in a foreign-based company. This is represented for the investor acquiring 10% or more of the ordinary shares or voting shares of a foreign company. However, that definition is flexible, as there are many cases where effective controlling interest in a firm can be established with less than 10% of the company's voting shares.

Foreign direct investments are commonly categorized as being horizontal, vertical or conglomerate in nature. A horizontal direct investment refers to the investor establishing the same type of business operation in a foreign country as it operates in its home country, for example, a cell phone provider based in the United States opening up stores in China. A vertical investment is one in which different but related business activities from the investor's main business are established or acquired in a foreign country, such as when a manufacturing company acquires an interest in a foreign company that supplies parts or materials required for the manufacturing company to make its products. A conglomerate type of foreign direct investment is one where a company or individual makes a direct investment in a business that is unrelated to its existing business in its home country. Since this type of investment involves entering an industry the investor has no prior experience in, it often takes the form of a joint venture with a foreign company already operating in the industry.

5.29 VENTURE CAPITAL

Venture capital is financing that investors provide to startup companies and small businesses that are believed to have long-term growth potential. Venture capital generally comes from well-off investors, investment banks and any other financial institutions. However, it does not always take just a monetary form; it can be provided in the form of technical or managerial expertise.

Though it can be risky for the investors who put up the funds, the potential for above-average returns is an attractive payoff. For new companies or ventures that have a limited operating history (under two years), venture capital funding is increasingly becoming a popular – even essential – source for raising capital, especially if they lack access to capital markets, bank loans or other debt instruments. The main downside is that the investors usually get equity in the company, and thus a say in company decisions.

5.29.1 ANGEL INVESTORS

For small businesses, or for up-and-coming businesses in emerging industries, venture capital is generally provided by high net worth individuals (HNWIs) – also often known as "angel investors" – and venture capital firms. The National Venture Capital Association (NVCA) is an organization composed of hundreds of venture capital firms that offer funding to innovative enterprises.

Angel investors are typically a diverse group of individuals who have amassed their wealth through a variety of sources. However, they tend to be entrepreneurs themselves, or executives recently retired from the business empires they've built.

Self-made investors providing venture capital typically share several key characteristics. The majority look to invest in companies that are well-managed, have a fully-developed business plan and are poised for substantial growth. These investors are also likely to offer funding to ventures that are involved in the same or similar industries or business sectors with which they are familiar. If they haven't actually worked in that field, they might have had academic training in it. Another common occurrence among angel investors is co-investing, where one angel investor funds a venture alongside a trusted friend or associate, often another angel investor.

5.29.2 THE VENTURE CAPITAL PROCESS

The first step for any business looking for venture capital is to submit a business plan, either to a venture capital firm or to an angel investor. If interested in the proposal, the firm or the investor must then perform due diligence, which includes a thorough investigation of the company's business model, products, management and operating history, among other things.

Since venture capital tends to invest larger dollar amounts in fewer companies, this background research is very important. Many venture capital professionals have had prior investment experience, often as equity research analysts; others have Masters in Business Administration (MBA) degrees. Venture capital professionals also tend to concentrate in a particular industry. A venture capitalist that specializes in healthcare, for example, may have had prior experience as a healthcare industry analyst.

Once due diligence has been completed, the firm or the investor will pledge an investment of capital in exchange for equity in the company. These funds may be provided all at once, but more typically the capital is provided in rounds. The firm or investor then takes an active role in the funded company, advising and monitoring its progress before releasing additional funds.

The investor exits the company after a period of time, typically four to six years after the initial investment, by initiating a merger, acquisition or initial public offering (IPO).

REVIEW QUESTIONS

1) Explain in brief the concept of entrepreneur.
2) Give various definitions of entrepreneur.
3) Explain in brief the functions of entrepreneur.
4) Explain in brief the concept of entrepreneurship.
5) Explain in brief the evolution of entrepreneurship.
6) Explain in brief the role of entrepreneurship in economic development.
7) Explain in brief the stages in entrepreneurial process.
8) What do you mean by small-scale industry? List the characteristics of small-scale industries.
9) Discuss the scope of MSME.
10) Explain the role of MSME in economic development
11) Explain in brief the steps involved in starting an MSME.
12) Explain all India institutions supporting entrepreneurs.
13) Write a short note on following
    a) TECKSOK
    b) KIADB
    c) KSSIDC
    d) DIC Single Window agency
    e) SISI
    f) NSIC
    g) SIDBI
    h) KSFC
14) Explain briefly Business planning process.
15) What are the guidelines for preparation of model project report for starting a new venture.
16) Write a short notes on
a) International Entrepreneurship opportunities
b) Exporting
c) Direct foreign investment
d) Venture capital

4

TABLE FOR DISCRE
SERIES, COMPOUND
INTEREST FACTOR

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.003	.9975	1.0000	1.0025	1.000	0.998	0.000	0.000	1
2	1.005	.9950	.4994	.5019	2.003	1.993	0.499	0.995	2
3	1.008	.9925	.3325	.3350	3.008	2.985	0.998	2.980	3
4	1.010	.9901	.2491	.2516	4.015	3.975	1.497	5.950	4
5	1.013	.9876	.1990	.2015	5.025	4.963	1.995	9.901	5
6	1.015	.9851	.1656	.1681	6.038	5.948	2.493	14.826	6
7	1.018	.9827	.1416	.1441	7.053	6.931	2.990	20.722	7
8	1.020	.9802	.1239	.1264	8.070	7.911	3.487	27.584	8
9	1.023	.9778	.1100	.1125	9.091	8.889	3.983	35.406	9
10	1.025	.9753	.0989	.1014	10.113	9.864	4.479	44.184	10
11	1.028	.9729	.0898	.0923	11.139	10.837	4.975	53.913	11
12	1.030	.9705	.0822	.0847	12.167	11.807	5.470	64.589	12
13	1.033	.9681	.0758	.0783	13.197	12.775	5.965	76.205	13
14	1.036	.9656	.0703	.0728	14.230	13.741	6.459	88.759	14
15	1.038	.9632	.0655	.0680	15.266	14.704	6.953	102.244	15
16	1.041	.9608	.0613	.0638	16.304	15.665	7.447	116.657	16
17	1.043	.9584	.0577	.0602	17.344	16.624	7.944	131.992	17
18	1.046	.9561	.0544	.0569	18.388	17.580	8.433	148.245	18
19	1.049	.9537	.0515	.0540	19.434	18.533	8.925	165.411	19
20	1.051	.9513	.0488	.0513	20.482	19.485	9.417	183.485	20
21	1.054	.9489	.0464	.0489	21.534	20.434	9.908	202.463	21
22	1.056	.9465	.0443	.0468	22.587	21.380	10.400	222.341	22
23	1.059	.9442	.0423	.0448	23.644	22.324	10.890	243.113	23
24	1.062	.9418	.0405	.0430	24.703	23.266	11.380	264.773	24
25	1.064	.9395	.0388	.0413	25.765	24.206	11.870	287.324	25
26	1.067	.9371	.0373	.0398	26.829	25.143	12.360	310.752	26
27	1.070	.9348	.0358	.0383	27.896	26.078	12.849	335.057	27
28	1.072	.9325	.0345	.0370	28.966	27.010	13.337	360.233	28
29	1.075	.9301	.0333	.0358	30.038	27.940	13.825	386.278	29
30	1.078	.9278	.0321	.0346	31.114	28.868	14.313	413.185	30
31	1.094	.9140	.0266	.0291	37.621	34.387	17.251	592.899	36
32	1.105	.9049	.0236	.0261	42.014	38.020	19.167	728.740	40
33	1.127	.8871	.0196	.0221	50.932	45.179	23.021	1040.055	48
34	1.153	.8826	.0188	.0213	53.189	46.947	23.980	1125.777	50
35	1.159	.8782	.0180	.0205	55.458	48.705	24.938	1214.588	52
36	1.162	.8609	.0155	.0180	64.047	55.091	28.791	1586.085	60
37	1.191	.8395	.0131	.0156	76.395	64.144	33.681	2161.011	72
38	1.197	.8355	.0127	.0152	78.780	65.817	34.622	2278.557	74
39	1.221	.8189	.0113	.0138	88.440	72.427	38.869	2764.457	84
40	1.233	.8108	.0107	.0132	93.343	75.682	40.933	3079.754	88
41	1.252	.7987	.00992	.0124	100.789	80.504	42.810	3446.870	96
42	1.273	.7849	.00925	.0117	108.149	84.955	45.584	3873.283	104
43	1.294	.7730	.00881	.0113	113.491	87.722	47.422	4161.262	108
44	1.297	.7711	.00824	.0108	118.005	91.000	49.252	4484.447	112
45	1.346	.7411	.00716	.00966	139.741	103.563	56.508	5852.112	128
46	1.424	.7023	.00585	.00835	170.906	120.012	65.992	7919.965	144
47	1.457	.6870	.00522	.00772	191.745	131.745	71.580	9429.930	152
48	1.491	.6708	.00458	.00708	217.191	145.670	78.170	11390.752	160
49	1.526	.6551	.00398	.00648	251.274	164.623	86.261	14200.000	170
50	1.562	.6399	.00342	.00592	292.324	187.032	95.852	17926.000	180
51	1.599	.6252	.00290	.00540	344.352	215.309	107.943	23245.000	192
52	1.636	.6110	.00242	.00492	413.259	252.510	122.534	30938.000	204
53	1.674	.5973	.00198	.00448	504.046	301.045	139.625	42026.000	216
54	1.713	.5839	.00158	.00408	634.243	370.282	159.216	58956.000	228
55	1.753	.5710	.00122	.00372	819.000	467.756	181.307	84820.000	240
56	1.794	.5585	.00089	.00339	1123.700	627.571	205.898	129220.000	252
57	1.836	.5464	.00060	.00310	1659.049	906.449	232.989	211130.000	264
58	1.879	.5347	.00035	.00285	2856.556	1527.459	262.580	401039.000	276
59	1.923	.5234	.00013	.00263	7887.470	4128.780	294.671	1216653.000	288
60	1.968	.5125	.00000	.00250	∞	∞	329.262	∞	300

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.005	.9950	1.0000	1.0050	1.000	0.995	0	0	1
2	1.010	.9901	.4988	.5038	2.005	1.985	0.499	0.990	2
3	1.015	.9851	.3317	.3367	3.015	2.970	0.997	2.960	3
4	1.020	.9802	.2481	.2531	4.030	3.941	1.494	5.901	4
5	1.025	.9754	.1980	.2030	5.050	4.926	1.990	9.803	5
6	1.030	.9705	.1646	.1696	6.076	5.896	2.486	14.655	6
7	1.036	.9657	.1407	.1457	7.106	6.862	2.982	20.459	7
8	1.041	.9609	.1228	.1278	8.141	7.823	3.478	27.214	8
9	1.046	.9561	.1089	.1139	9.182	8.779	3.967	34.824	9
10	1.051	.9513	.0978	.1028	10.228	9.730	4.459	43.389	10
11	1.056	.9466	.0887	.0937	11.279	10.677	4.950	52.856	11
12	1.062	.9419	.0811	.0861	12.336	11.619	5.441	63.228	12
13	1.067	.9372	.0746	.0796	13.397	12.556	5.931	74.504	13
14	1.072	.9326	.0691	.0741	14.464	13.489	6.420	85.680	14
15	1.078	.9279	.0644	.0694	15.537	14.417	6.907	99.674	15
16	1.083	.9233	.0602	.0652	16.614	15.340	7.394	113.477	16
17	1.088	.9187	.0565	.0615	17.697	16.259	7.880	128.129	17
18	1.094	.9141	.0532	.0582	18.786	17.173	8.366	143.666	18
19	1.099	.9096	.0503	.0553	19.880	18.082	8.850	160.077	19
20	1.105	.9051	.0477	.0527	20.979	18.987	9.334	177.247	20
21	1.110	.9006	.0453	.0503	22.084	19.888	9.817	195.245	21
22	1.116	.8961	.0431	.0481	23.194	20.784	10.300	214.070	22
23	1.122	.8916	.0411	.0461	24.310	21.676	10.781	233.660	23
24	1.127	.8872	.0393	.0443	25.432	22.563	11.261	254.058	24
25	1.133	.8828	.0377	.0427	26.559	23.446	11.741	275.273	25
26	1.138	.8784	.0361	.0411	27.692	24.324	12.220	297.233	26
27	1.144	.8740	.0347	.0397	28.830	25.198	12.698	320.054	27
28	1.150	.8697	.0334	.0384	29.974	26.068	13.175	343.674	28
29	1.156	.8653	.0321	.0371	31.124	26.933	13.651	367.672	29
30	1.161	.8610	.0310	.0360	32.280	27.794	14.127	392.640	30
36	1.197	.8356	.0254	.0304	39.336	32.871	16.962	557.494	36
40	1.221	.8191	.0226	.0276	44.159	36.172	18.676	675.941	40
48	1.270	.7871	.0185	.0235	54.098	42.580	22.044	938.528	48
50	1.283	.7793	.0177	.0227	56.645	44.143	22.867	1009.701	50
52	1.296	.7716	.0169	.0219	59.218	45.693	23.678	1081.582	52
60	1.349	.7414	.0143	.0193	69.770	51.726	26.807	1386.155	60
72	1.431	.6986	.0116	.0166	86.409	60.340	31.351	1891.531	72
84	1.520	.6577	.0096	.0146	104.073	68.453	35.548	2432.555	84
90	1.567	.6383	.0087	.0137	114.034	72.791	37.629	2739.028	90
96	1.614	.6195	.0078	.0128	122.829	76.095	39.687	3020.419	96
100	1.647	.6073	.0073	.0123	129.334	78.543	41.041	3222.348	100
104	1.680	.5953	.0068	.0118	135.970	80.942	42.389	3430.279	104
120	1.819	.5496	.0051	.0101	163.880	90.074	47.951	4318.063	120
240	3.310	.3021	.0021	.0071	462.041	139.581	96.111	13413.390	240
360	6.023	.1660	.0010	.0060	1004.5	166.792	120.554	20103.32	360
480	10.957	.0911	.0005	.0055	1991.5	181.748	133.749	24308.35	480

3¼%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.008	.9926	1.0000	1.0075	1.000	0.993	0	0	1
2	1.015	.9852	.4981	.5056	2.008	1.978	0.499	0.987	2
3	1.023	.9778	.3308	.3383	3.023	2.956	0.996	2.943	3
4	1.030	.9706	.2472	.2547	4.045	3.926	1.492	5.857	4
5	1.038	.9633	.1970	.2045	5.076	4.889	1.986	9.712	5
6	1.046	.9562	.1636	.1711	6.114	5.846	2.479	14.494	6
7	1.054	.9490	.1397	.1472	7.160	6.795	2.971	20.187	7
8	1.062	.9420	.1218	.1293	8.213	7.737	3.462	26.785	8
9	1.070	.9350	.1078	.1153	9.275	8.672	3.951	34.265	9
10	1.078	.9280	.0967	.1042	10.344	9.600	4.440	42.619	10
11	1.086	.9211	.0876	.0951	11.422	10.521	4.927	51.831	11
12	1.094	.9142	.0800	.0875	12.508	11.435	5.412	61.889	12
13	1.102	.9074	.0735	.0810	13.602	12.342	5.897	72.779	13
14	1.110	.9007	.0680	.0755	14.704	13.243	6.380	84.491	14
15	1.119	.8940	.0632	.0707	15.814	14.137	6.862	97.005	15
16	1.127	.8873	.0591	.0666	16.932	15.024	7.343	110.318	16
17	1.135	.8807	.0554	.0629	18.059	15.905	7.822	124.410	17
18	1.144	.8742	.0521	.0596	19.195	16.779	8.300	139.273	18
19	1.153	.8676	.0492	.0567	20.339	17.647	8.777	154.891	19
20	1.161	.8612	.0465	.0540	21.491	18.508	9.253	171.254	20
21	1.170	.8548	.0441	.0516	22.653	19.363	9.727	188.352	21
22	1.179	.8484	.0420	.0495	23.823	20.211	10.201	206.170	22
23	1.188	.8421	.0400	.0475	25.001	21.053	10.673	223.695	23
24	1.196	.8358	.0382	.0457	26.189	21.889	11.143	243.924	24
25	1.205	.8296	.0365	.0440	27.385	22.719	11.613	264.834	25
26	1.214	.8234	.0350	.0425	28.591	23.542	12.081	284.421	26
27	1.224	.8173	.0336	.0411	29.805	24.360	12.548	305.672	27
28	1.233	.8112	.0322	.0397	31.029	25.171	13.014	327.576	28
29	1.242	.8052	.0310	.0385	32.261	25.976	13.479	350.122	29
30	1.251	.7992	.0298	.0373	33.503	26.775	13.942	373.302	30
36	1.309	.7641	.0243	.0318	41.153	31.447	16.696	525.038	36
40	1.348	.7416	.0215	.0290	46.447	34.447	18.507	637.519	40
48	1.431	.6986	.0174	.0249	57.521	40.185	22.070	886.899	48
50	1.453	.6882	.0166	.0241	60.395	41.567	22.949	953.911	50
52	1.475	.6780	.0158	.0233	63.312	42.928	23.822	1022.64	52
60	1.566	.6387	.0133	.0208	75.425	48.174	27.268	1313.59	60
70	1.687	.5927	.0109	.0184	91.621	54.305	31.465	1708.68	70
72	1.713	.5839	.0105	.0180	95.008	55.477	32.289	1791.33	72
80	1.818	.5500	.00917	.0167	109.071	59.995	35.540	2132.23	80
84	1.873	.5338	.00859	.0161	116.428	62.154	37.137	2308.22	84
90	1.959	.5104	.00782	.0155	127.881	65.275	39.496	2578.09	90
96	2.049	.4881	.00715	.0147	139.858	68.259	41.812	2854.04	96
100	2.111	.4737	.00675	.0143	148.147	70.175	43.332	3040.85	100
104	2.175	.4597	.00638	.0139	156.687	72.035	44.834	3229.60	104
120	2.451	.4079	.00517	.0127	193.517	78.942	50.653	3998.68	120
240	6.009	.1664	.00150	.00900	667.901	111.145	85.422	9491.26	240
360	14.751	.0679	.00055	.00805	1830.8	124.282	107.115	13312.50	360
480	36.111	.0277	.00021	.00771	4681.5	129.641	119.662	15513.16	480

1%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.010	.9901	1.0000	1.0100	1.000	0.990	0	0	1
2	1.020	.9803	.4975	.5075	2.010	1.970	0.498	0.980	2
3	1.030	.9706	.3300	.3400	3.030	2.941	0.993	2.921	3
4	1.041	.9610	.2463	.2563	4.060	3.902	1.488	5.804	4
5	1.051	.9515	.1960	.2060	5.101	4.853	1.980	9.610	5
6	1.062	.9420	.1625	.1725	6.152	5.795	2.471	14.321	6
7	1.072	.9327	.1386	.1486	7.214	6.728	2.960	19.917	7
8	1.083	.9235	.1207	.1307	8.286	7.652	3.448	26.381	8
9	1.094	.9143	.1067	.1167	9.369	8.566	3.934	33.695	9
10	1.105	.9053	.0956	.1056	10.462	9.471	4.418	41.843	10
11	1.116	.8963	.0865	.0965	11.567	10.368	4.900	50.806	11
12	1.127	.8874	.0788	.0888	12.682	11.255	5.381	60.568	12
13	1.138	.8787	.0724	.0824	13.809	12.134	5.861	71.112	13
14	1.149	.8700	.0669	.0769	14.947	13.004	6.338	82.422	14
15	1.161	.8613	.0621	.0721	16.097	13.865	6.814	94.481	15
16	1.173	.8528	.0579	.0679	17.258	14.718	7.289	107.273	16
17	1.184	.8444	.0543	.0643	18.430	15.562	7.761	120.783	17
18	1.196	.8360	.0510	.0610	19.615	16.398	8.232	134.999	18
19	1.208	.8277	.0481	.0581	20.811	17.226	8.702	149.906	19
20	1.220	.8195	.0454	.0554	22.019	18.046	9.169	165.492	20
21	1.232	.8114	.0430	.0530	23.239	18.857	9.635	181.744	21
22	1.245	.8034	.0409	.0509	24.472	19.660	10.100	198.653	22
23	1.257	.7954	.0389	.0489	25.716	20.456	10.563	216.205	23
24	1.270	.7876	.0371	.0471	26.973	21.243	11.024	234.379	24
25	1.282	.7798	.0354	.0454	28.243	22.023	11.483	253.197	25
26	1.295	.7720	.0339	.0439	29.526	22.795	11.941	272.595	26
27	1.308	.7644	.0324	.0424	30.821	23.560	12.397	292.589	27
28	1.321	.7568	.0311	.0411	32.129	24.316	12.852	313.204	28
29	1.335	.7493	.0299	.0399	33.450	25.066	13.304	333.426	29
30	1.348	.7419	.0287	.0387	34.785	25.808	13.756	355.201	30
36	1.431	.6989	.0232	.0332	43.077	30.107	16.428	494.620	36
40	1.489	.6717	.0205	.0305	48.886	32.835	18.178	596.854	40
48	1.612	.6203	.0163	.0263	61.223	37.974	21.598	820.144	48
50	1.645	.6080	.0155	.0255	64.463	39.196	22.436	879.417	50
52	1.678	.5961	.0148	.0248	67.769	40.394	23.269	939.916	52
60	1.817	.5504	.0122	.0222	81.670	44.955	26.533	1192.80	60
70	2.007	.4983	.00993	.0199	100.676	50.168	30.470	1528.64	70
72	2.047	.4885	.00955	.0196	104.710	51.150	31.239	1597.86	72
80	2.217	.4511	.00822	.0182	121.671	54.888	34.249	1879.87	80
84	2.307	.4335	.00765	.0177	130.672	56.648	35.717	2023.81	84
90	2.449	.4084	.00690	.0169	144.863	59.161	37.872	2240.56	90
96	2.599	.3847	.00625	.0163	159.927	61.528	39.973	2459.42	96
100	2.705	.3697	.00587	.0159	170.481	63.029	41.343	2605.77	100
104	2.815	.3553	.00551	.0155	181.464	64.471	42.688	2752.17	104
120	3.300	.3030	.00435	.0143	230.039	69.701	47.835	3334.18	120
240	10.893	.0918	.00101	.0110	989.254	90.819	75.779	6883.39	240
360	35.950	.0278	.00029	.0103	3495.0	97.218	89.699	8720.61	360
480	118.648	.00843	.00008	.0101	11764.8	99.157	99.930	9910.15	480

1½%

Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	
1	1.015	.9877	1.0000	1.0125	1.000	0.988	0	0	1
2	1.025	.9755	.4969	.5094	2.013	1.963	0.497	0.976	2
3	1.038	.9634	.3292	.3417	3.038	2.927	0.992	2.904	3
4	1.051	.9515	.2454	.2579	4.076	3.878	1.485	5.759	4
5	1.064	.9398	.1951	.2076	5.127	4.818	1.976	9.518	5
6	1.077	.9282	.1615	.1740	6.191	5.746	2.464	14.160	6
7	1.091	.9167	.1376	.1501	7.268	6.663	2.951	19.660	7
8	1.104	.9054	.1196	.1321	8.359	7.568	3.435	25.998	8
9	1.118	.8942	.1057	.1182	9.463	8.462	3.918	33.152	9
10	1.132	.8832	.0945	.1070	10.582	9.346	4.398	41.101	10
11	1.146	.8723	.0854	.0979	11.714	10.218	4.876	49.825	11
12	1.161	.8615	.0778	.0903	12.860	11.079	5.352	59.302	12
13	1.175	.8509	.0713	.0838	14.021	11.930	5.827	69.513	13
14	1.190	.8404	.0658	.0783	15.196	12.771	6.299	80.438	14
15	1.205	.8300	.0610	.0735	16.386	13.601	6.769	92.058	15
16	1.220	.8197	.0568	.0693	17.591	14.420	7.237	104.355	16
17	1.235	.8096	.0532	.0657	18.811	15.230	7.702	117.309	17
18	1.251	.7996	.0499	.0624	20.046	16.030	8.166	130.903	18
19	1.266	.7898	.0470	.0595	21.297	16.849	8.628	145.119	19
20	1.282	.7800	.0443	.0568	22.563	17.599	9.088	159.940	20
21	1.298	.7704	.0419	.0544	23.845	18.370	9.545	175.348	21
22	1.314	.7609	.0398	.0523	25.143	19.131	10.001	191.327	22
23	1.331	.7515	.0378	.0503	26.458	19.882	10.455	207.859	23
24	1.347	.7422	.0360	.0485	27.788	20.624	10.906	224.930	24
25	1.364	.7330	.0343	.0468	29.136	21.357	11.355	242.523	25
26	1.381	.7240	.0328	.0453	30.500	22.081	11.803	260.623	26
27	1.399	.7150	.0314	.0439	31.881	22.796	12.248	279.215	27
28	1.416	.7062	.0300	.0425	32.280	23.503	12.691	298.284	28
29	1.434	.6975	.0288	.0413	34.696	24.200	13.133	317.814	29
30	1.452	.6889	.0277	.0402	36.129	24.889	13.572	337.792	30
34	1.564	.6394	.0222	.0347	45.116	28.847	16.164	466.297	34
40	1.644	.6084	.0194	.0319	51.490	31.327	17.852	559.247	40
48	1.845	.5509	.0153	.0278	65.229	35.932	21.130	759.248	48
50	1.861	.5373	.0145	.0270	68.882	37.013	21.930	811.692	50
52	1.938	.5242	.0138	.0263	72.628	38.068	22.722	864.960	52
60	2.107	.4746	.0113	.0238	88.575	42.035	25.809	1084.86	60
72	2.446	.4191	.00902	.0215	110.873	46.470	29.492	1370.47	72
80	2.701	.4088	.00864	.0211	115.675	47.293	30.205	1428.48	80
84	2.839	.3702	.00735	.0198	136.120	50.387	32.983	1661.89	84
90	3.079	.3522	.00680	.0193	147.130	51.822	34.326	1778.86	90
96	3.324	.3269	.00607	.0186	164.706	53.846	36.286	1953.85	96
100	3.495	.3034	.00545	.0179	183.643	55.725	38.180	2127.55	100
104	3.671	.2887	.00507	.0176	197.074	56.901	39.406	2242.26	104
120	4.440	.2747	.00474	.0172	211.190	58.021	40.604	2355.90	120
240	19.716	.2253	.00363	.0161	275.220	61.983	45.119	2796.59	240
360	87.565	.0507	.00067	.0126	1497.3	75.942	67.177	5101.55	360
480	388.713	.0114	.00014	.0125	6923.4	79.086	75.840	5997.91	480
		.00253	.00003		31017.1	79.794	78.762	6284.74	

1½%

Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	
1	1.015	.9852	1.0000	1.0150	1.000	0.985	0	0	1
2	1.030	.9707	.4963	.5113	2.015	1.956	0.496	0.970	2
3	1.046	.9563	.3284	.3434	3.045	2.912	0.990	2.883	3
4	1.061	.9422	.2444	.2594	4.091	3.854	1.481	5.709	4
5	1.077	.9283	.1941	.3091	5.152	4.783	1.970	9.422	5
6	1.093	.9145	.1605	.1755	6.230	5.697	2.456	13.994	6
7	1.110	.9010	.1366	.1516	7.323	6.598	2.940	19.400	7
8	1.126	.8877	.1186	.1336	8.433	7.486	3.422	25.614	8
9	1.143	.8746	.1046	.1196	9.559	8.360	3.901	32.610	9
10	1.161	.8617	.0934	.1084	10.703	9.222	4.377	40.365	10
11	1.178	.8489	.0843	.0993	11.863	10.071	4.851	48.855	11
12	1.196	.8364	.0767	.0917	13.041	10.907	5.322	58.054	12
13	1.214	.8240	.0702	.0852	14.237	11.731	5.791	67.943	13
14	1.232	.8118	.0647	.0797	15.450	12.543	6.258	78.496	14
15	1.250	.7999	.0599	.0749	16.682	13.343	6.722	89.694	15
16	1.269	.7880	.0558	.0708	17.932	14.131	7.184	101.514	16
17	1.288	.7764	.0521	.0671	19.201	14.908	7.643	113.937	17
18	1.307	.7649	.0488	.0638	20.489	15.673	8.100	126.940	18
19	1.327	.7536	.0459	.0609	21.797	16.426	8.554	140.505	19
20	1.347	.7425	.0432	.0582	23.124	17.169	9.005	154.611	20
21	1.367	.7315	.0409	.0559	24.470	17.900	9.455	169.241	21
22	1.388	.7207	.0387	.0537	25.837	18.621	9.902	184.375	22
23	1.408	.7100	.0367	.0517	27.225	19.331	10.346	199.996	23
24	1.430	.6995	.0349	.0499	28.633	20.030	10.788	216.085	24
25	1.451	.6892	.0333	.0483	30.063	20.720	11.227	232.626	25
26	1.473	.6790	.0317	.0467	31.514	21.399	11.664	249.601	26
27	1.495	.6690	.0303	.0453	32.987	22.067	12.099	266.995	27
28	1.517	.6591	.0290	.0440	34.481	22.727	12.531	284.790	28
29	1.540	.6494	.0278	.0428	35.999	23.376	12.961	302.972	29
30	1.563	.6398	.0266	.0416	37.539	24.016	13.388	321.525	30
34	1.709	.5851	.0212	.0362	47.276	27.661	15.901	439.823	34
40	1.814	.5513	.0184	.0334	54.268	29.916	17.528	524.349	40
48	2.043	.4894	.0144	.0294	69.565	34.042	20.666	703.537	48
50	2.105	.4750	.0136	.0286	73.682	35.000	21.428	749.955	50
52	2.169	.4611	.0128	.0278	77.925	35.929	22.179	796.868	52
60	2.443	.4093	.0104	.0254	96.214	39.380	25.093	988.157	60
70	2.835	.3527	.00817	.0232	122.363	43.155	28.529	1231.15	70
72	2.921	.3423	.00781	.0228	128.076	43.845	29.189	1279.78	72
80	3.291	.3039	.00655	.0215	152.710	46.407	31.742	1473.06	80
84	3.493	.2863	.00602	.0210	166.172	47.579	32.967	1568.50	84
90	3.819	.2619	.00532	.0203	187.929	49.210	34.740	1709.53	90
96	4.176	.2395	.00472	.0197	211.719	50.702	36.438	1847.46	96
100	4.432	.2256	.00437	.0194	228.802	51.625	37.529	1937.43	100
104	4.704	.2126	.00405	.0190	246.932	52.494	38.589	2025.89	104
120	5.969	.1675	.00302	.0160	331.280	55.498	42.518	2359.69	120
240	35.632	.0281	.00043	.0154	2308.8	64.796	59.737	3870.68	240
360	212.700	.00470	.00007	.0151	14113.3	66.353	64.969	4310.71	360
480	1269.7	.00079	.00001	.0150	84577.8	66.614	66.255	4413.74	480

1¾%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.018	.9828	1.0000	1.0175	1.000	0.983	0	0	1
2	1.035	.9659	.4957	.5132	2.018	1.949	0.496	0.966	2
3	1.053	.9493	.3276	.3451	3.053	2.898	0.989	2.865	3
4	1.072	.9330	.2435	.2610	4.106	3.831	1.478	5.664	4
5	1.091	.9169	.1931	.2106	5.178	4.748	1.965	9.332	5
6	1.110	.9011	.1595	.1770	6.269	5.649	2.450	13.837	6
7	1.129	.8856	.1355	.1530	7.378	6.535	2.931	19.152	7
8	1.149	.8704	.1175	.1350	8.508	7.405	3.409	25.245	8
9	1.169	.8554	.1036	.1211	9.656	8.261	3.885	32.088	9
10	1.189	.8407	.0924	.1099	10.825	9.101	4.357	39.655	10
11	1.210	.8263	.0832	.1007	12.015	9.928	4.827	47.918	11
12	1.231	.8121	.0756	.0931	13.225	10.740	5.294	56.851	12
13	1.253	.7981	.0692	.0867	14.457	11.538	5.758	66.428	13
14	1.275	.7844	.0637	.0812	15.710	12.322	6.219	76.625	14
15	1.297	.7709	.0589	.0764	16.985	13.093	6.677	87.417	15
16	1.320	.7576	.0547	.0722	18.282	13.851	7.132	98.782	16
17	1.343	.7446	.0510	.0685	19.602	14.595	7.584	110.695	17
18	1.367	.7318	.0477	.0652	20.945	15.327	8.034	123.136	18
19	1.390	.7192	.0448	.0623	22.311	16.046	8.481	136.081	19
20	1.415	.7068	.0422	.0597	23.702	16.753	8.924	149.511	20
21	1.440	.6947	.0398	.0573	25.116	17.448	9.365	163.405	21
22	1.465	.6827	.0377	.0552	26.556	18.130	9.804	177.742	22
23	1.490	.6710	.0357	.0532	28.021	18.801	10.239	192.503	23
24	1.516	.6594	.0339	.0514	29.511	19.461	10.671	207.671	24
25	1.543	.6481	.0322	.0497	31.028	20.109	11.101	223.225	25
26	1.570	.6369	.0307	.0482	32.571	20.746	11.528	239.149	26
27	1.597	.6260	.0293	.0468	34.141	21.372	11.952	255.425	27
28	1.625	.6152	.0280	.0455	35.738	21.987	12.373	272.036	28
29	1.654	.6046	.0268	.0443	37.363	22.592	12.791	288.967	29
30	1.683	.5942	.0256	.0431	39.017	23.186	13.206	306.200	30
36	1.867	.5355	.0202	.0377	49.566	26.543	15.640	415.130	36
40	2.002	.4996	.0175	.0350	57.234	28.594	17.207	492.017	40
48	2.300	.4349	.0135	.0310	74.263	32.294	20.209	652.612	48
50	2.381	.4200	.0127	.0302	78.903	33.141	20.932	693.708	50
52	2.465	.4057	.0119	.0294	83.706	33.960	21.644	735.039	52
60	2.832	.3531	.00955	.0271	104.676	36.964	24.389	901.503	60
70	3.366	.2969	.00739	.0249	135.331	40.178	27.586	1108.34	70
72	3.487	.2868	.00704	.0245	142.127	40.757	28.195	1149.12	72
80	4.006	.2496	.00582	.0233	171.795	42.880	30.533	1309.25	80
84	4.294	.2329	.00531	.0228	188.746	43.836	31.644	1387.16	84
90	4.765	.2098	.00465	.0221	215.166	45.152	33.241	1500.88	90
96	5.288	.1891	.00408	.0216	245.039	46.337	34.756	1610.48	96
100	5.668	.1764	.00375	.0212	266.753	47.062	35.721	1681.09	100
104	6.075	.1646	.00345	.0209	290.028	47.737	36.652	1749.68	104
120	8.019	.1247	.00249	.0200	401.099	50.017	40.047	2003.03	120
240	64.308	.0156	.00028	.0178	3617.6	56.254	53.352	3001.27	240
360	515.702	.00194	.00003	.0175	294115	57.032	56.443	3219.08	360
480	4135.5	.00024		.0175	236259.0	57.129	57.027	3257.88	480

2%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.020	.9804	1.0000	1.0200	1.000	0.980	0	0	1
2	1.040	.9612	.4951	.5151	2.020	1.942	0.495	0.961	2
3	1.061	.9423	.3268	.3468	3.060	2.884	0.987	2.846	3
4	1.082	.9238	.2426	.2626	4.122	3.808	1.475	5.617	4
5	1.104	.9057	.1922	.2122	5.204	4.713	1.960	9.240	5
6	1.126	.8880	.1585	.1785	6.308	5.601	2.442	13.679	6
7	1.149	.8706	.1345	.1545	7.434	6.472	2.921	18.903	7
8	1.172	.8535	.1165	.1365	8.583	7.325	3.396	24.877	8
9	1.195	.8368	.1025	.1225	9.755	8.162	3.868	31.571	9
10	1.219	.8203	.0913	.1113	10.950	8.983	4.337	38.954	10
11	1.243	.8043	.0822	.1022	12.169	9.787	4.802	46.996	11
12	1.268	.7885	.0746	.0946	13.412	10.575	5.264	55.669	12
13	1.294	.7730	.0681	.0881	14.680	11.348	5.723	64.946	13
14	1.319	.7579	.0626	.0826	15.974	12.106	6.178	74.798	14
15	1.346	.7430	.0578	.0778	17.293	12.849	6.631	85.200	15
16	1.373	.7284	.0537	.0737	18.639	13.578	7.080	96.127	16
17	1.400	.7142	.0500	.0700	20.012	14.292	7.526	107.553	17
18	1.428	.7002	.0467	.0667	21.412	14.992	7.968	119.456	18
19	1.457	.6864	.0438	.0638	22.840	15.678	8.407	131.812	19
20	1.486	.6730	.0412	.0612	24.297	16.351	8.843	144.598	20
21	1.516	.6598	.0388	.0588	25.783	17.011	9.276	157.793	21
22	1.546	.6468	.0366	.0566	27.299	17.658	9.705	171.377	22
23	1.577	.6342	.0347	.0547	28.845	18.292	10.132	185.328	23
24	1.608	.6217	.0329	.0529	30.422	18.914	10.555	199.628	24
25	1.641	.6095	.0312	.0512	32.030	19.523	10.974	214.256	25
26	1.673	.5976	.0297	.0497	33.671	20.121	11.391	229.196	26
27	1.707	.5859	.0283	.0483	35.344	20.707	11.804	244.428	27
28	1.741	.5744	.0270	.0470	37.051	21.281	12.214	259.936	28
29	1.776	.5631	.0258	.0458	38.792	21.844	12.621	275.703	29
30	1.811	.5521	.0247	.0447	40.568	22.396	13.025	291.713	30
36	2.040	.4902	.0192	.0392	51.994	25.489	15.381	392.036	36
40	2.208	.4529	.0166	.0366	60.402	27.355	16.888	461.939	40
48	2.587	.3865	.0126	.0326	79.353	30.673	19.755	605.961	48
50	2.692	.3715	.0118	.0318	84.579	31.424	20.442	642.355	50
52	2.800	.3571	.0111	.0311	90.016	32.145	21.116	678.779	52
60	3.281	.3048	.00877	.0288	114.051	34.761	23.696	823.692	60
70	4.000	.2500	.00667	.0267	149.977	37.499	26.663	999.829	70
72	4.161	.2403	.00633	.0263	158.056	37.984	27.223	1034.050	72
80	4.875	.2051	.00516	.0252	193.771	39.744	29.357	1166.781	80
84	5.277	.1895	.00468	.0247	213.865	40.525	30.361	1230.413	84
90	5.943	.1683	.00405	.0240	247.155	41.587	31.793	1322.164	90
96	6.693	.1494	.00351	.0235	284.645	42.529	33.137	1409.291	96
100	7.245	.1380	.00320	.0232	312.230	43.098	33.986	1464.747	100
104	7.842	.1275	.00292	.0229	342.090	43.624	34.799	1518.082	104
120	10.765	.0929	.00205	.0220	488.255	45.355	37.711	1710.411	120
240	115.887	.00863	.00017	.0202	5744.4	49.569	47.911	2374.478	240
360	1247.5	.00080	.00002	.0200	62326.8	49.960	49.711	2483.567	360
480	13429.8	.00007		.0200	671442.0	49.996	49.964	2498.027	480

2½%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.025	.9756	1.0000	1.0250	1.000	0.976	0	0	1
2	1.051	.9518	.4938	.5188	2.025	1.927	0.494	0.952	2
3	1.077	.9286	.3251	.3501	3.076	2.856	0.984	2.809	3
4	1.104	.9060	.2408	.2658	4.153	3.762	1.469	5.527	4
5	1.131	.8839	.1902	.2152	5.256	4.646	1.951	9.062	5
6	1.160	.8623	.1566	.1816	6.388	5.508	2.428	13.374	6
7	1.189	.8413	.1325	.1575	7.547	6.349	2.901	18.421	7
8	1.218	.8207	.1145	.1395	8.736	7.170	3.370	24.166	8
9	1.249	.8007	.1005	.1255	9.955	7.971	3.835	30.572	9
10	1.280	.7812	.0893	.1143	11.203	8.752	4.296	37.603	10
11	1.312	.7621	.0801	.1051	12.483	9.514	4.753	45.224	11
12	1.345	.7436	.0725	.0975	13.796	10.258	5.206	53.403	12
13	1.379	.7254	.0660	.0910	15.140	10.983	5.655	62.108	13
14	1.413	.7077	.0605	.0855	16.519	11.691	6.100 →	71.309	14
15	1.448	.6905	.0558	.0808	17.932	12.381	6.540	80.975	15
16	1.485	.6736	.0516	.0766	19.380	13.055	6.977	91.080	16
17	1.522	.6572	.0479	.0729	20.865	13.712	7.409	101.595	17
18	1.560	.6412	.0447	.0697	22.386	14.353	7.838	112.495	18
19	1.599	.6255	.0418	.0668	23.946	14.979	8.262	123.754	19
20	1.639	.6103	.0391	.0641	25.545	15.589	8.682	135.349	20
21	1.680	.5954	.0368	.0618	27.183	16.185	9.099	147.257	21
22	1.722	.5809	.0346	.0596	28.863	16.765	9.511	159.455	22
23	1.765	.5667	.0327	.0577	30.584	17.332	9.919	171.922	23
24	1.809	.5529	.0309	.0559	32.349	17.885	10.324	184.638	24
25	1.854	.5394	.0293	.0543	34.158	18.424	10.724	197.584	25
26	1.900	.5262	.0278	.0528	36.012	18.951	11.120	210.740	26
27	1.948	.5134	.0264	.0514	37.912	19.464	11.513	224.088	27
28	1.996	.5009	.0251	.0501	39.860	19.965	11.901	237.612	28
29	2.046	.4887	.0239	.0489	41.856	20.454	12.286	251.294	29
30	2.098	.4767	.0228	.0478	43.903	20.930	12.667	265.120	30
31	2.150	.4651	.0217	.0467	46.000	21.395	13.044	279.073	31
32	2.204	.4538	.0208	.0458	48.150	24.849	13.417	293.140	32
33	2.259	.4427	.0199	.0449	50.354	22.292	13.786	307.306	33
34	2.315	.4319	.0190	.0440	52.613	22.724	14.151	321.559	34
35	2.373	.4214	.0182	.0432	54.928	23.145	14.512	335.886	35
40	2.685	.3724	.0148	.0398	67.402	25.103	16.262	408.221	40
45	3.038	.3292	.0123	.0373	81.516	26.833	17.918	480.806	45
50	3.437	.2909	.0103	.0353	97.484	28.362	19.484	552.807	50
55	3.889	.2572	.00865	.0337	115.551	29.714	20.961	622.827	55
60	4.400	.2273	.00735	.0324	135.991	30.909	22.352	690.865	60
65	4.978	.2009	.00628	.0313	159.118	31.965	23.660	756.780	65
70	5.632	.1776	.00540	.0304	185.284	32.898	24.888	818.763	70
75	6.372	.1569	.00465	.0297	214.888	33.723	26.039	878.114	75
80	7.210	.1387	.00403	.0290	248.382	34.452	27.117	934.217	80
85	8.157	.1226	.00349	.0285	286.278	35.096	28.123	987.026	85
90	9.229	.1084	.00304	.0280	329.154	35.666	29.063	1036.54	90
95	10.442	.0958	.00265	.0276	377.663	36.169	29.938	1082.83	95
100	11.814	.0846	.00231	.0273	432.548	36.614	30.752	1125.97	100

3%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.030	.9709	1.0000	1.0300	1.000	0.971	0	0	1
2	1.061	.9426	.4926	.5226	2.030	1.913	0.493	0.943	2
3	1.093	.9151	.3235	.3535	3.091	2.829	0.980	2.773	3
4	1.126	.8885	.2390	.2690	4.184	3.717	1.463	5.438	4
5	1.159	.8626	.1884	.2184	5.309	4.580	1.941	8.889	5
6	1.194	.8375	.1546	.1846	6.468	5.417	2.414	13.076	6
7	1.230	.8131	.1305	.1605	7.662	6.230	2.882	17.955	7
8	1.267	.7894	.1125	.1425	8.892	7.020	3.345	23.481	8
9	1.305	.7664	.0984	.1284	10.159	7.786	3.803	29.612	9
10	1.344	.7441	.0872	.1172	11.464	8.530	4.256	36.309	10
11	1.384	.7224	.0781	.1081	12.808	9.253	4.705	43.533	11
12	1.426	.7014	.0705	.1005	14.192	9.954	5.148	51.248	12
13	1.469	.6810	.0640	.0940	15.618	10.635	5.587	59.419	13
14	1.513	.6611	.0585	.0885	17.086	11.296	6.021	68.014	14
15	1.558	.6419	.0538	.0838	18.599	11.938	6.450	77.000	15
16	1.605	.6232	.0496	.0796	20.157	12.561	6.874	86.348	16
17	1.653	.6050	.0460	.0760	21.762	13.166	7.294	96.028	17
18	1.702	.5874	.0427	.0727	23.414	13.754	7.708	106.014	18
19	1.754	.5703	.0398	.0698	25.117	14.324	8.118	116.279	19
20	1.806	.5537	.0372	.0672	26.870	14.877	8.523	126.799	20
21	1.860	.5375	.0349	.0649	28.676	15.415	8.923	137.549	21
22	1.916	.5219	.0327	.0627	30.537	15.937	9.319	148.509	22
23	1.974	.5067	.0308	.0608	32.453	16.444	9.709	159.656	23
24	2.033	.4919	.0290	.0590	34.426	16.936	10.095	170.971	24
25	2.094	.4776	.0274	.0574	36.459	17.413	10.477	182.433	25
26	2.157	.4637	.0259	.0559	38.553	17.877	10.853	194.026	26
27	2.221	.4502	.0246	.0546	40.710	18.327	11.226	205.731	27
28	2.288	.4371	.0233	.0533	42.931	18.764	11.593	217.532	28
29	2.357	.4243	.0221	.0521	45.219	19.188	11.956	229.413	29
30	2.427	.4120	.0210	.0510	47.575	19.600	12.314	241.361	30
31	2.500	.4000	.0200	.0500	50.003	20.000	12.668	253.361	31
32	2.575	.3883	.0190	.0490	52.503	20.389	13.017	265.399	32
33	2.652	.3770	.0182	.0482	55.078	20.766	13.362	277.464	33
34	2.732	.3660	.0173	.0473	57.730	21.132	13.702	289.544	34
35	2.814	.3554	.0165	.0465	60.462	21.487	14.037	301.627	35
40	3.262	.3066	.0133	.0433	75.401	23.115	15.650	361.750	40
45	3.782	.2644	.0108	.0408	92.720	24.519	17.156	420.632	45
50	4.384	.2281	.00887	.0389	112.797	25.730	18.558	477.480	50
55	5.082	.1968	.00735	.0373	136.072	26.774	19.860	531.741	55
60	5.892	.1697	.00613	.0361	163.053	27.676	21.067	583.052	60
65	6.830	.1464	.00515	.0351	194.333	28.453	22.184	631.201	65
70	7.918	.1263	.00434	.0343	230.594	29.123	23.215	676.087	70
75	9.179	.1089	.00367	.0337	272.631	29.702	24.163	717.698	75
80	10.641	.0940	.00311	.0331	321.363	30.201	25.035	756.086	80
85	12.336	.0811	.00265	.0326	377.857	30.631	25.835	791.353	85
90	14.300	.0699	.00226	.0323	443.349	31.002	26.567	823.630	90
95	16.578	.0603	.00193	.0319	519.272	31.323	27.235	853.074	95
100	19.219	.0520	.00165	.0316	607.287	31.599	27.844	879.854	100

3 1/2 %

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.035	.9662	1.0000	1.0350	1.000	0.966	0	0	1
2	1.071	.9335	.4914	.5264	2.035	1.900	0.491	0.933	2
3	1.109	.9019	.3219	.3569	3.106	2.802	0.977	2.737	3
4	1.148	.8714	.2373	.2723	4.215	3.673	1.457	5.352	4
5	1.188	.8420	.1865	.2215	5.362	4.515	1.931	8.719	5
6	1.229	.8135	.1527	.1877	6.550	5.329	2.400	12.787	6
7	1.272	.7860	.1285	.1635	7.779	6.115	2.862	17.503	7
8	1.317	.7594	.1105	.1455	9.052	6.874	3.320	22.819	8
9	1.363	.7337	.0964	.1314	10.368	7.608	3.771	28.688	9
10	1.411	.7089	.0852	.1202	11.731	8.317	4.217	35.069	10
11	1.460	.6849	.0761	.1111	13.142	9.002	4.657	41.918	11
12	1.511	.6618	.0685	.1035	14.602	9.663	5.091	49.198	12
13	1.564	.6394	.0621	.0971	16.113	10.303	5.520	56.871	13
14	1.619	.6178	.0566	.0916	17.677	10.921	5.943	64.902	14
15	1.675	.5969	.0518	.0868	19.296	11.517	6.361	73.258	15
16	1.734	.5767	.0477	.0827	20.971	12.094	6.773	81.909	16
17	1.795	.5572	.0440	.0790	22.705	12.651	7.179	90.824	17
18	1.857	.5384	.0408	.0758	24.500	13.190	7.580	99.976	18
19	1.922	.5202	.0379	.0729	26.357	13.710	7.975	109.339	19
20	1.990	.5026	.0354	.0704	28.280	14.212	8.365	118.888	20
21	2.059	.4856	.0330	.0680	30.269	14.698	8.749	128.599	21
22	2.132	.4692	.0309	.0659	32.329	15.167	9.128	138.451	22
23	2.206	.4533	.0290	.0640	34.460	15.620	9.502	148.423	23
24	2.283	.4380	.0273	.0623	36.666	16.058	9.870	158.496	24
25	2.363	.4231	.0257	.0607	38.950	16.482	10.233	168.652	25
26	2.446	.4088	.0242	.0592	41.313	16.890	10.590	178.873	26
27	2.532	.3950	.0229	.0579	43.759	17.285	10.942	189.143	27
28	2.620	.3817	.0216	.0566	46.291	17.667	11.289	199.448	28
29	2.712	.3687	.0204	.0554	48.911	18.036	11.631	209.773	29
30	2.807	.3563	.0194	.0544	51.623	18.392	11.967	220.105	30
31	2.905	.3442	.0184	.0534	54.429	18.736	12.299	230.432	31
32	3.007	.3326	.0174	.0524	57.334	19.069	12.625	240.742	32
33	3.112	.3213	.0166	.0516	60.341	19.390	12.946	251.025	33
34	3.221	.3105	.0158	.0508	63.453	19.701	13.262	261.271	34
35	3.334	.3000	.0150	.0500	66.674	20.001	13.573	271.470	35
40	3.959	.2526	.0118	.0468	84.550	21.355	15.055	321.490	40
45	4.702	.2127	.00945	.0445	105.781	22.495	16.417	369.307	45
50	5.585	.1791	.00763	.0426	130.998	23.456	17.666	414.369	50
55	6.633	.1508	.00621	.0412	160.946	24.264	18.808	456.352	55
60	7.878	.1269	.00509	.0401	196.516	24.945	19.848	495.104	60
65	9.357	.1069	.00419	.0392	238.762	25.518	20.793	530.598	65
70	11.113	.0900	.00346	.0385	288.937	26.000	21.650	562.895	70
75	13.199	.0758	.00287	.0379	348.529	26.407	22.423	592.121	75
80	15.676	.0638	.00238	.0374	419.305	26.749	23.120	618.438	80
85	18.618	.0537	.00199	.0370	503.365	27.037	23.747	642.036	85
90	22.112	.0452	.00166	.0367	603.202	27.279	24.308	663.118	90
95	26.262	.0381	.00139	.0364	721.778	27.483	24.811	681.890	95
100	31.191	.0321	.00116	.0362	862.608	27.655	25.259	698.554	100

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.040	.9615	1.0000	1.0400	1.000	0.962	0	0	1
2	1.082	.9246	.4902	.5302	2.040	1.886	0.490	0.925	2
3	1.125	.8890	.3203	.3603	3.122	2.775	0.974	2.702	3
4	1.170	.8548	.2355	.2755	4.246	3.630	1.451	5.267	4
5	1.217	.8219	.1846	.2246	5.416	4.452	1.922	8.555	5
6	1.265	.7903	.1508	.1908	6.633	5.242	2.386	12.506	6
7	1.316	.7599	.1266	.1666	7.898	6.002	2.843	17.066	7
8	1.369	.7307	.1085	.1485	9.214	6.733	3.294	22.180	8
9	1.423	.7026	.0945	.1345	10.583	7.435	3.739	27.801	9
10	1.480	.6756	.0833	.1233	12.006	8.111	4.177	33.881	10
11	1.539	.6496	.0741	.1141	13.486	8.760	4.609	40.377	11
12	1.601	.6246	.0666	.1066	15.026	9.385	5.034	47.248	12
13	1.665	.6006	.0601	.1001	16.627	9.986	5.453	54.454	13
14	1.732	.5775	.0547	.0947	18.292	10.563	5.866	61.962	14
15	1.801	.5553	.0499	.0899	20.024	11.118	6.272	69.735	15
16	1.873	.5339	.0458	.0858	21.825	11.652	6.672	77.744	16
17	1.948	.5134	.0422	.0822	23.697	12.166	7.066	85.954	17
18	2.026	.4936	.0390	.0790	25.645	12.659	7.453	94.339	18
19	2.107	.4746	.0361	.0761	27.671	13.134	7.834	102.893	19
20	2.191	.4564	.0336	.0736	29.778	13.590	8.209	111.564	20
21	2.279	.4388	.0313	.0713	31.969	14.029	8.578	120.341	21
22	2.370	.4220	.0292	.0692	34.248	14.451	8.941	129.202	22
23	2.465	.4057	.0273	.0673	36.618	14.857	9.297	138.128	23
24	2.563	.3901	.0256	.0656	39.083	15.247	9.648	147.101	24
25	2.666	.3751	.0240	.0640	41.646	15.622	9.993	156.104	25
26	2.772	.3607	.0226	.0626	44.312	15.983	10.331	165.121	26
27	2.883	.3468	.0212	.0612	47.084	16.330	10.664	174.138	27
28	2.999	.3335	.0200	.0600	49.968	16.663	10.991	183.142	28
29	3.119	.3207	.0189	.0589	52.966	16.984	11.312	192.120	29
30	3.243	.3083	.0178	.0578	56.085	17.292	11.627	201.062	30
31	3.373	.2965	.0169	.0569	59.328	17.588	11.937	209.955	31
32	3.508	.2851	.0159	.0559	62.701	17.874	12.241	218.792	32
33	3.648	.2741	.0151	.0551	66.209	18.148	12.540	227.563	33
34	3.794	.2636	.0143	.0543	69.858	18.411	12.832	236.260	34
35	3.946	.2534	.0135	.0535	73.652	18.665	13.120	244.876	35
40	4.801	.2083	.0105	.0505	95.025	19.793	14.476	286.530	40
45	5.841	.1712	.00826	.0483	121.029	20.720	15.705	325.402	45
50	7.107	.1407	.00655	.0466	152.667	21.482	16.812	361.163	50
55	8.646	.1157	.00523	.0452	191.159	22.109	17.807	393.689	55
60	10.520	.0951	.00420	.0442	237.990	22.623	18.697	422.996	60
65	12.799	.0781	.00339	.0434	294.968	23.047	19.491	449.201	65
70	15.572	.0642	.00275	.0427	364.290	23.395	20.196	472.479	70
75	18.945	.0528	.00223	.0422	448.631	23.680	20.821	493.041	75
80	23.050	.0434	.00181	.0418	551.244	23.915	21.372	511.116	80
85	28.044	.0357	.00148	.0415	676.089	24.109	21.854	526.950	85
90	34.119	.0293	.00121	.0412	827.983	24.267	22.273	540.737	90
95	41.511	.0241	.00099	.0410	1012.8	24.398	22.633	552.730	95
100	50.505	.0198	.00081	.0408	1237.6	24.505	22.950	563.125	100

Compound Interest Factors — 4½%

	Single Payment		Uniform Payment Series			Arithmetic Gradient		
	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	n
1	1.045	.9569	1.0000	1.0450	1.000	0.957	0	0	1
2	1.092	.9157	.4890	.5340	2.045	1.873	0.489	0.916	2
3	1.141	.8763	.3188	.3638	3.137	2.749	0.971	2.668	3
4	1.193	.8386	.2337	.2787	4.278	3.588	1.445	5.184	4
5	1.246	.8025	.1828	.2278	5.471	4.390	1.912	8.393	5
6	1.302	.7679	.1489	.1939	6.717	5.158	2.372	12.233	6
7	1.361	.7348	.1247	.1697	8.019	5.893	2.824	16.642	7
8	1.422	.7032	.1066	.1516	9.380	6.596	3.269	21.564	8
9	1.486	.6729	.0926	.1376	10.802	7.269	3.707	26.948	9
10	1.553	.6439	.0814	.1264	12.288	7.913	4.138	32.743	10
11	1.623	.6162	.0722	.1172	13.841	8.529	4.562	38.905	11
12	1.696	.5897	.0647	.1097	15.464	9.119	4.978	45.391	12
13	1.772	.5643	.0583	.1033	17.160	9.683	5.387	52.163	13
14	1.852	.5400	.0528	.0978	18.932	10.223	5.789	59.182	14
15	1.935	.5167	.0481	.0931	20.784	10.740	6.184	66.416	15
16	2.022	.4945	.0440	.0890	22.719	11.234	6.572	73.833	16
17	2.113	.4732	.0404	.0854	24.742	11.707	6.953	81.404	17
18	2.208	.4528	.0372	.0822	26.855	12.160	7.327	89.107	18
19	2.308	.4333	.0344	.0794	29.064	12.593	7.695	96.921	19
20	2.412	.4146	.0319	.0769	31.371	13.008	8.055	104.829	20
21	2.520	.3968	.0296	.0746	33.783	13.405	8.409	112.815	21
22	2.634	.3797	.0275	.0725	36.303	13.784	8.755	120.869	22
23	2.752	.3634	.0257	.0707	38.937	14.148	9.096	128.982	23
24	2.876	.3477	.0240	.0690	41.689	14.495	9.429	137.146	24
25	3.005	.3327	.0224	.0674	44.565	14.828	9.756	145.355	25
26	3.141	.3184	.0210	.0660	47.571	15.147	10.077	152.603	26
27	3.282	.3047	.0197	.0647	50.711	15.451	10.391	160.887	27
28	3.430	.2916	.0185	.0635	53.993	15.743	10.698	168.420	28
29	3.584	.2790	.0174	.0624	57.423	16.022	10.999	176.232	29
30	3.745	.2670	.0164	.0614	61.007	16.289	11.295	183.975	30
31	3.914	.2555	.0154	.0604	64.752	16.544	11.583	191.690	31
32	4.090	.2445	.0146	.0596	68.666	16.789	11.866	199.220	32
33	4.274	.2340	.0137	.0587	72.756	17.023	12.143	206.707	33
34	4.466	.2239	.0130	.0580	77.030	17.247	12.414	214.095	34
35	4.667	.2143	.0123	.0573	81.497	17.461	12.679	221.380	35
40	5.816	.1719	.00914	.0543	107.030	18.402	13.913	256.098	40
45	7.248	.1380	.00720	.0522	138.850	19.156	15.020	287.392	45
50	9.033	.1107	.00560	.0506	176.503	19.762	15.998	316.145	50
55	11.256	.0888	.00439	.0494	222.918	20.248	16.860	341.375	55
60	14.027	.0713	.00345	.0485	289.497	20.638	17.617	363.574	60
65	17.481	.0572	.00271	.0477	366.237	20.951	18.278	382.990	65
70	21.784	.0459	.00217	.0472	461.869	21.202	18.854	399.190	70
75	27.143	.0368	.00172	.0467	581.043	21.404	19.353	412.242	75
80	33.830	.0296	.00137	.0464	729.556	21.563	19.785	422.469	80
85	42.158	.0237	.00109	.0461	914.630	21.695	20.157	430.359	85
90	52.557	.0190	.00087	.0459	1 145.3	21.799	20.476	446.359	90
95	65.471	.0153	.00070	.0457	1 432.7	21.885	20.749	454.039	95
100	81.588	.0123	.00056	.0456	1 790.9	21.950	20.981	460.537	100

Compound Interest Factor — 5%

	Single Payment		Uniform Payment Series			Arithmetic Gradient		
n	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	n
1	1.050	.9524	1.0000	1.0500	1.000	0.952	0	0	1
2	1.102	.9070	.4878	.5378	2.050	1.859	0.488	0.907	2
3	1.158	.8638	.3172	.3672	3.152	2.723	0.967	2.635	3
4	1.216	.8227	.2320	.2820	4.310	3.546	1.439	5.103	4
5	1.276	.7835	.1810	.2310	5.526	4.329	1.902	8.237	5
6	1.340	.7462	.1470	.1970	6.802	5.076	2.358	11.968	6
7	1.407	.7107	.1228	.1728	8.142	5.786	2.805	16.232	7
8	1.477	.6768	.1047	.1547	9.549	6.463	3.244	20.970	8
9	1.551	.6446	.0907	.1407	11.027	7.108	3.676	26.127	9
10	1.629	.6139	.0795	.1295	12.578	7.722	4.099	31.652	10
11	1.710	.5847	.0704	.1204	14.207	8.306	4.514	37.499	11
12	1.796	.5568	.0628	.1128	15.917	8.863	4.922	43.624	12
13	1.886	.5303	.0565	.1065	17.713	9.394	5.321	49.988	13
14	1.980	.5051	.0510	.1010	19.599	9.899	5.713	56.553	14
15	2.079	.4810	.0463	.0963	21.579	10.380	6.097	63.288	15
16	2.183	.4581	.0423	.0923	23.657	10.838	6.474	70.159	16
17	2.292	.4363	.0387	.0887	25.840	11.274	6.842	77.140	17
18	2.407	.4155	.0355	.0855	28.132	11.690	7.203	84.204	18
19	2.527	.3957	.0327	.0827	30.539	12.085	7.557	91.327	19
20	2.653	.3769	.0302	.0802	33.066	12.462	7.903	98.488	20
21	2.786	.3589	.0280	.0780	35.719	12.821	8.242	105.667	21
22	2.925	.3419	.0260	.0760	38.505	13.163	8.573	112.846	22
23	3.072	.3256	.0241	.0741	41.430	13.489	8.897	120.008	23
24	3.225	.3101	.0225	.0725	44.502	13.799	9.214	127.140	24
25	3.386	.2953	.0210	.0710	47.727	14.094	9.524	134.227	25
26	3.556	.2812	.0196	.0696	51.113	14.375	9.827	141.258	26
27	3.733	.2678	.0183	.0683	54.669	14.643	10.122	148.222	27
28	3.920	.2551	.0171	.0671	58.402	14.898	10.411	155.110	28
29	4.116	.2429	.0160	.0660	62.323	15.141	10.694	161.912	29
30	4.322	.2314	.0151	.0651	66.439	15.372	10.969	168.622	30
31	4.538	.2204	.0141	.0641	70.761	15.593	11.238	175.233	31
32	4.765	.2099	.0133	.0633	75.299	15.803	11.501	181.739	32
33	5.003	.1999	.0125	.0625	80.063	16.003	11.757	188.135	33
34	5.253	.1904	.0118	.0618	85.067	16.193	12.006	194.416	34
35	5.516	.1813	.0111	.0611	90.320	16.374	12.250	200.580	35
40	7.040	.1420	.00828	.0583	120.799	17.159	13.377	229.545	40
45	8.985	.1113	.00626	.0563	159.699	17.774	14.364	255.314	45
50	11.467	.0872	.00478	.0548	209.347	18.256	15.223	277.914	50
55	14.636	.0683	.00367	.0537	272.711	18.633	15.966	297.510	55
60	18.679	.0535	.00283	.0528	353.582	18.929	16.606	314.343	60
65	23.840	.0419	.00219	.0522	456.795	19.161	17.154	328.691	65
70	30.426	.0329	.00170	.0517	588.525	19.343	17.621	340.841	70
75	38.832	.0258	.00132	.0513	756.649	19.485	18.018	351.072	75
80	49.561	.0202	.00103	.0510	971.222	19.596	18.353	359.646	80
85	63.254	.0158	.00080	.0508	1245.1	19.684	18.633	366.800	85
90	80.730	.0124	.00063	.0506	1594.6	19.752	18.871	372.749	90
95	103.034	.00971	.00049	.0505	2040.7	19.806	19.069	377.677	95
100	131.500	.00760	.00038	.0503	2610.0	19.848	19.234	381.749	100

6%

Compounding Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.060	.9434	1.0000	1.0600	1.000	0.943	0	0	1
2	1.124	.8900	.4854	.5454	2.060	1.833	0.485	0.890	2
3	1.191	.8396	.3141	.3741	3.184	2.673	0.961	2.569	3
4	1.262	.7921	.2286	.2886	4.375	3.465	1.427	4.945	4
5	1.338	.7473	.1774	.2374	5.637	4.212	1.884	7.934	5
6	1.419	.7050	.1434	.2034	6.975	4.917	2.330	11.459	6
7	1.504	.6651	.1191	.1791	8.394	5.582	2.768	15.450	7
8	1.594	.6274	.1010	.1610	9.897	6.210	3.195	19.841	8
9	1.689	.5919	.0870	.1470	11.491	6.802	3.613	24.577	9
10	1.791	.5584	.0759	.1359	13.181	7.360	4.022	29.602	10
11	1.898	.5268	.0668	.1268	14.972	7.887	4.421	34.870	11
12	2.012	.4970	.0593	.1193	16.870	8.384	4.811	40.337	12
13	2.133	.4688	.0530	.1130	18.882	8.853	5.192	45.963	13
14	2.261	.4423	.0476	.1076	21.015	9.295	5.564	51.713	14
15	2.397	.4173	.0430	.1030	23.276	9.712	5.926	57.554	15
16	2.540	.2936	.0390	.0990	25.672	10.106	6.279	63.459	16
17	2.693	.3714	.0354	.0954	28.213	10.477	6.624	69.401	17
18	2.854	.3503	.0324	.0924	30.906	10.828	6.960	75.357	18
19	3.026	.3305	.0296	.0896	33.760	11.158	7.287	81.306	19
20	3.207	.3118	.0272	.0872	36.786	11.470	7.605	87.230	20
21	3.400	.2942	.0250	.0850	39.993	11.764	7.915	93.113	21
22	3.604	.2775	.0230	.0830	43.392	12.042	8.217	98.941	22
23	3.820	.2618	.0213	.0813	46.996	12.303	8.510	104.700	23
24	4.049	.2470	.0197	.0797	50.815	12.550	8.795	110.381	24
25	4.292	.2330	.0182	.0782	54.864	12.783	9.072	115.973	25
26	4.549	.2198	.0169	.0769	59.156	13.003	9.341	121.468	26
27	4.822	.2074	.0157	.0757	63.706	13.211	9.603	126.860	27
28	5.112	.1956	.0146	.0746	68.528	13.406	9.857	132.142	28
29	5.418	.1846	.0136	.0736	73.640	13.591	10.103	137.309	29
30	5.743	.1741	.0126	.0726	79.058	13.765	10.342	142.359	30
31	6.088	.1643	.0118	.0718	84.801	13.929	10.574	147.286	31
32	6.453	.1550	.0110	.0710	90.890	14.084	10.799	152.090	32
33	6.841	.1462	.0103	.0703	97.343	14.230	11.017	156.768	33
34	7.251	.1379	.00960	.0696	104.184	14.368	11.228	161.319	34
35	7.686	.1301	.00897	.0690	111.435	14.498	11.432	165.743	35
40	10.286	.0972	.00646	.0665	154.762	15.046	12.359	185.957	40
45	13.765	.0727	.00470	.0647	212.743	15.456	13.141	203.109	45
50	18.420	.0543	.00344	.0634	290.335	15.762	13.796	217.457	50
55	24.650	.0406	.00254	.0625	394.171	15.991	14.341	229.322	55
60	32.988	.0303	.00188	.0619	533.126	16.161	14.791	239.043	60
65	44.145	.0227	.00139	.0614	719.080	16.289	15.160	246.945	65
70	59.076	.0169	.00103	.0610	967.928	16.385	15.461	253.327	70
75	79.057	.0126	.00077	.0608	1300.9	16.456	15.706	258.453	75
80	105.796	.00945	.00057	.0606	1746.6	16.509	15.903	262.549	80
85	141.578	.00706	.00043	.0604	2343.0	16.549	16.062	265.810	85
90	189.464	.00528	.00032	.0603	3141.1	16.579	16.189	268.395	90
95	253.545	.00394	.00024	.0602	4209.1	16.601	16.290	270.437	95
100	339.300	.00295	.00018	.0602	5638.3	16.618	16.371	272.047	100

7%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.070	.9346	1.0000	1.0700	1.000	0.935	0	0	1
2	1.145	.8734	.4831	.5531	2.070	1.808	0.483	0.873	2
3	1.225	.8163	.3111	.3811	3.215	2.624	0.954	2.506	3
4	1.311	.7629	.2252	.2952	4.440	3.387	1.416	4.795	4
5	1.403	.7130	.1739	.2439	5.751	4.100	1.865	7.647	5
6	1.501	.6663	.1398	.2098	7.153	4.767	2.303	10.978	6
7	1.606	.6227	.1156	.1856	8.654	5.389	2.730	14.715	7
8	1.718	.5820	.0975	.1675	10.260	5.971	3.147	18.789	8
9	1.838	.5439	.0835	.1535	11.978	6.515	3.552	23.140	9
10	1.967	.5083	.0724	.1424	13.816	7.024	3.946	27.716	10
11	2.105	.4751	.0634	.1334	15.784	7.499	4.330	32.464	11
12	2.252	.4440	.0559	.1259	17.888	7.943	4.703	37.332	12
13	2.410	.4150	.0497	.1197	20.141	8.358	5.065	42.280	13
14	2.579	.3878	.0443	.1143	22.551	8.745	5.417	47.272	14
15	2.759	.3624	.0398	.1098	25.129	9.108	5.758	52.266	15
16	2.952	.3387	.0359	.1059	27.888	9.447	6.090	57.527	16
17	3.159	.3166	.0324	.1024	30.840	9.763	6.411	62.592	17
18	3.380	.2959	.0294	.0994	33.999	10.059	6.722	67.622	18
19	3.617	.2765	.0268	.0968	37.379	10.336	7.024	72.599	19
20	3.870	.2584	.0244	.0944	40.996	10.594	7.316	77.509	20
21	4.141	.2415	.0223	.0923	44.865	10.836	7.599	82.339	21
22	4.430	.2257	.0204	.0904	49.006	11.061	7.872	87.079	22
23	4.741	.2109	.0187	.0887	53.436	11.272	8.137	91.720	23
24	5.072	.1971	.0172	.0872	58.177	11.469	8.392	96.255	24
25	5.427	.1842	.0158	.0858	63.249	11.654	8.639	100.677	25
26	5.807	.1722	.0146	.0846	68.677	11.826	8.877	104.981	26
27	6.214	.1609	.0134	.0834	74.484	11.987	9.107	109.166	27
28	6.649	.1504	.0124	.0824	80.698	12.137	9.329	113.227	28
29	7.114	.1406	.0114	.0814	87.347	12.278	9.543	117.162	29
30	7.612	.1314	.0106	.0806	94.461	12.409	9.749	120.972	30
31	8.145	.1228	.00980	.0798	102.073	12.532	9.947	124.655	31
32	8.715	.1147	.00907	.0791	110.218	12.647	10.138	128.212	32
33	9.325	.1072	.00841	.0784	118.934	12.754	10.322	131.644	33
34	9.978	.1002	.00780	.0778	128.259	12.854	10.499	134.951	34
35	10.677	.0937	.00723	.0772	138.237	12.948	10.669	138.135	35
40	14.974	.0668	.00501	.0750	199.636	13.332	11.423	152.293	40
45	21.002	.0476	.00350	.0735	285.750	13.606	12.036	163.756	45
50	29.457	.0339	.00246	.0725	406.530	13.801	12.529	172.905	50
55	41.315	.0242	.00174	.0717	575.930	13.940	12.921	180.124	55
60	57.947	.0173	.00123	.0712	813.523	14.039	13.232	185.768	60
65	81.273	.0123	.00087	.0709	1146.8	14.110	13.476	190.145	65
70	113.990	.00877	.00062	.0706	1614.1	14.160	13.666	193.519	70
75	159.877	.00625	.00044	.0704	2269.7	14.196	13.814	196.104	75
80	224.235	.00446	.00031	.0703	3189.1	14.222	13.927	198.075	80
85	314.502	.00318	.00022	.0702	4478.6	14.240	14.015	199.572	85
90	441.105	.00227	.00016	.0702	6287.2	14.253	14.080	200.704	90
95	618.673	.00162	.00011	.0701	8823.9	14.263	14.132	201.558	95
100	867.720	.00115	.00008	.0701	12381.7	14.269	14.170	202.200	100

Compound Interest Factors 8%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor Find F Given P	Present Worth Factor Find P Given F	Sinking Fund Factor Find A Given F	Capital Recovery Factor Find A Given P	Compound Amount Factor Find F Given A	Present Worth Factor Find P Given A	Gradient Uniform Series Find A Given G	Gradient Present Worth Find P Given G	
n	F/P	P/F	A/F	A/P	F/A	P/A	A/G	P/G	n
1	1.080	.9259	1.0000	1.0800	1.000	0.926	0	0	1
2	1.166	.8573	.4808	.5608	2.080	1.783	0.481	0.857	2
3	1.260	.7938	.3080	.3880	3.246	2.577	0.949	2.445	3
4	1.360	.7350	.2219	.3019	4.506	3.312	1.404	4.650	4
5	1.469	.6806	.1705	.2505	5.867	3.993	1.846	7.372	5
6	1.587	.6302	.1363	.2163	7.336	4.623	2.276	10.523	6
7	1.714	.5835	.1121	.1921	8.923	5.206	2.694	14.024	7
8	1.851	.5403	.0940	.1740	10.637	5.747	3.099	17.806	8
9	1.999	.5002	.0801	.1601	12.488	6.247	3.491	21.808	9
10	2.159	.4632	.0690	.1490	14.487	6.710	3.871	25.977	10
11	2.332	.4289	.0601	.1401	16.645	7.139	4.240	30.266	11
12	2.518	.3971	.0527	.1327	18.977	7.536	4.596	34.634	12
13	2.720	.3677	.0465	.1265	21.495	7.904	4.940	39.046	13
14	2.937	.3405	.0413	.1213	24.215	8.244	5.273	43.472	14
15	3.172	.3152	.0368	.1168	27.152	8.559	5.594	47.886	15
16	3.426	.2919	.0330	.1130	30.324	8.851	5.905	52.264	16
17	3.700	.2703	.0296	.1096	33.750	9.122	6.204	56.588	17
18	3.996	.2502	.0267	.1067	37.450	9.372	6.492	60.843	18
19	4.316	.2317	.0241	.1041	41.446	9.604	6.770	65.013	19
20	4.661	.2145	.0219	.1019	45.762	9.818	7.037	69.090	20
21	5.034	.1987	.0198	.0998	50.423	10.017	7.294	73.063	21
22	5.437	.1839	.0180	.0980	55.457	10.201	7.541	76.926	22
23	5.871	.1703	.0164	.0964	60.893	10.371	7.779	80.673	23
24	6.341	.1577	.0150	.0950	66.765	10.529	8.007	84.300	24
25	6.848	.1460	.0137	.0937	73.106	10.675	8.225	87.804	25
26	7.396	.1352	.0125	.0925	79.954	10.810	8.435	91.184	26
27	7.988	.1252	.0114	.0914	87.351	10.935	8.636	94.439	27
28	8.627	.1159	.0105	.0905	95.339	11.051	8.829	97.569	28
29	9.317	.1073	.00962	.0896	103.966	11.158	9.013	100.574	29
30	10.063	.0994	.00883	.0888	113.283	11.258	9.190	103.456	30
31	10.868	.0920	.00811	.0881	123.346	11.350	9.358	106.216	31
32	11.737	.0852	.00745	.0875	134.214	11.435	9.520	108.858	32
33	12.676	.0789	.00685	.0869	145.951	11.514	9.674	111.382	33
34	13.690	.0730	.00630	.0863	158.627	11.587	9.821	113.792	34
35	14.785	.0676	.00580	.0858	172.317	11.655	9.961	116.092	35
40	21.725	.0460	.00386	.0839	259.057	11.925	10.570	126.042	40
45	31.920	.0313	.00259	.0826	386.506	12.108	11.045	133.733	45
50	46.902	.0213	.00174	.0817	573.771	12.233	11.411	139.593	50
55	68.914	.0145	.00118	.0812	848.925	12.319	11.690	144.006	55
60	101.257	.00988	.00080	.0808	1253.2	12.377	11.902	147.300	60
65	148.780	.00672	.00054	.0805	1847.3	12.416	12.059	149.739	65
70	218.607	.00457	.00037	.0804	2720.1	12.443	12.178	151.533	70
75	321.205	.00311	.00025	.0802	4002.6	12.461	12.266	152.845	75
80	471.956	.00212	.00017	.0802	5887.0	12.474	12.330	153.809	80
85	693.458	.00144	.00012	.0801	8655.7	12.482	12.377	154.492	85
90	1018.9	.00098	.00008	.0801	12724.0	12.488	12.412	154.993	90
95	1497.1	.00067	.00005	.0801	18701.6	12.492	12.437	155.352	95
100	2199.8	.00045	.00003	.0800	27484.6	12.493	12.455	155.611	100

Compound Interest Factors 9%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor Find F Given P	Present Worth Factor Find P Given F	Sinking Fund Factor Find A Given F	Capital Recovery Factor Find A Given P	Compound Amount Factor Find F Given A	Present Worth Factor Find P Given A	Gradient Uniform Series Find A Given G	Gradient Present Worth Find P Given G	
n	F/P	P/F	A/F	A/P	F/A	P/A	A/G	P/G	n
1	1.090	.9174	1.0000	1.0900	1.000	0.917	0	0	1
2	1.188	.8417	.4785	.5685	2.090	1.759	0.478	0.842	2
3	1.295	.7722	.3051	.3951	3.278	2.531	0.943	2.386	3
4	1.412	.7084	.2187	.3087	4.573	3.240	1.393	4.511	4
5	1.539	.6499	.1671	.2571	5.985	3.890	1.828	7.111	5
6	1.677	.5963	.1329	.2229	7.523	4.486	2.250	10.092	6
7	1.828	.5470	.1087	.1987	9.200	5.033	2.657	13.375	7
8	1.993	.5019	.0907	.1807	11.028	5.535	3.051	16.888	8
9	2.172	.4604	.0768	.1668	13.021	5.995	3.431	20.571	9
10	2.367	.4224	.0658	.1558	15.193	6.418	3.798	24.373	10
11	2.580	.3875	.0569	.1469	17.560	6.805	4.151	28.248	11
12	2.813	.3555	.0497	.1397	20.141	7.161	4.491	32.159	12
13	3.066	.3262	.0436	.1336	22.953	7.487	4.818	36.073	13
14	3.342	.2992	.0384	.1284	26.019	7.786	5.133	39.965	14
15	3.642	.2745	.0341	.1241	29.361	8.061	5.435	43.807	15
16	3.970	.2519	.0303	.1203	33.003	8.313	5.724	47.585	16
17	4.328	.2311	.0270	.1170	36.974	8.544	6.002	51.282	17
18	4.717	.2120	.0242	.1142	41.301	8.756	6.269	54.886	18
19	5.142	.1945	.0217	.1117	46.019	8.950	6.524	58.387	19
20	5.604	.1784	.0195	.1095	51.160	9.129	6.767	61.777	20
21	6.109	.1637	.0176	.1076	56.765	9.292	7.001	65.051	21
22	6.659	.1502	.0159	.1059	62.873	9.442	7.223	68.205	22
23	7.258	.1378	.0144	.1044	69.532	9.580	7.436	71.236	23
24	7.911	.1264	.0130	.1030	76.790	9.707	7.638	74.143	24
25	8.623	.1160	.0118	.1018	84.701	9.823	7.832	76.927	25
26	9.399	.1064	.0107	.1007	93.324	9.929	8.016	79.586	26
27	10.245	.0976	.00973	.0997	102.723	10.027	8.191	82.124	27
28	11.167	.0895	.00885	.0989	112.968	10.116	8.357	84.542	28
29	12.172	.0822	.00806	.0981	124.136	10.198	8.515	86.842	29
30	13.268	.0754	.00734	.0973	136.308	10.274	8.666	89.028	30
31	14.462	.0691	.00669	.0967	149.575	10.343	8.808	91.102	31
32	15.763	.0634	.00610	.0961	164.037	10.406	8.943	93.069	32
33	17.182	.0582	.00556	.0956	179.801	10.464	9.072	94.931	33
34	18.728	.0534	.00508	.0951	196.983	10.518	9.193	96.693	34
35	20.414	.0490	.00464	.0946	215.711	10.567	9.308	98.359	35
40	31.409	.0318	.00296	.0930	337.883	10.757	9.796	105.376	40
45	48.327	.0207	.00190	.0919	525.860	10.881	10.160	110.556	45
50	74.358	.0134	.00123	.0912	815.085	10.962	10.430	114.325	50
55	114.409	.00874	.00079	.0908	1260.1	11.014	10.626	117.036	55
60	176.032	.00568	.00051	.0905	1944.8	11.048	10.768	118.968	60
65	270.847	.00369	.00033	.0903	2998.3	11.070	10.870	120.334	65
70	416.731	.00240	.00022	.0902	4619.2	11.084	10.943	121.294	70
75	641.193	.00156	.00014	.0901	7113.3	11.093	10.994	121.965	75
80	986.555	.00101	.00009	.0901	10950.6	11.100	11.030	122.431	80
85	1517.9	.00066	.00006	.0901	16854.9	11.104	11.055	122.753	85
90	2335.5	.00043	.00004	.0900	25939.1	11.106	11.071	122.976	90
95	3593.5	.00028	.00003	.0900	39916.8	11.108	11.085	123.129	95
100	5529.1	.00018	.00002	.0900	61422.9	11.109	11.093	123.233	100

10%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.100	.9091	1.0000	1.1000	1.000	0.909	0	0	1
2	1.210	.8264	.4762	.5762	2.100	1.736	0.476	0.826	2
3	1.331	.7513	.3021	.4021	3.310	2.487	0.937	2.329	3
4	1.464	.6830	.2155	.3155	4.641	3.170	1.381	4.378	4
5	1.611	.6209	.1638	.2638	6.105	3.791	1.810	6.862	5
6	1.772	.5645	.1296	.2296	7.716	4.355	2.224	9.684	6
7	1.949	.5132	.1054	.2054	9.487	4.868	2.622	12.763	7
8	2.144	.4665	.0874	.1874	11.436	5.335	3.004	16.029	8
9	2.358	.4241	.0736	.1736	13.579	5.759	3.372	19.421	9
10	2.594	.3855	.0627	.1627	15.937	6.145	3.725	22.891	10
11	2.853	.3505	.0540	.1540	18.531	6.495	4.064	26.396	11
12	3.138	.3186	.0468	.1468	21.384	6.814	4.388	29.901	12
13	3.452	.2897	.0408	.1408	24.523	7.103	4.699	33.377	13
14	3.797	.2633	.0357	.1357	27.975	7.367	4.996	36.801	14
15	4.177	.2394	.0315	.1315	31.772	7.606	5.279	40.152	15
16	4.595	.2176	.0278	.1278	35.950	7.824	5.549	43.416	16
17	5.054	.1978	.0247	.1247	40.545	8.022	5.807	46.582	17
18	5.560	.1799	.0219	.1219	45.599	8.201	6.053	49.640	18
19	6.116	.1635	.0195	.1195	51.159	8.365	6.286	52.583	19
20	6.728	.1486	.0175	.1175	57.275	8.514	6.508	55.407	20
21	7.400	.1351	.0156	.1156	64.003	8.649	6.719	58.110	21
22	8.140	.1228	.0140	.1140	71.403	8.772	6.919	60.689	22
23	8.954	.1117	.0126	.1126	79.543	8.883	7.108	63.146	23
24	9.850	.1015	.0113	.1113	88.497	8.985	7.288	65.481	24
25	10.835	.0923	.0102	.1102	98.347	9.077	7.458	67.696	25
26	11.918	.0839	.00916	.1092	109.182	9.161	7.619	69.794	26
27	13.110	.0763	.00826	.1083	121.100	9.237	7.770	71.777	27
28	14.421	.0693	.00745	.1075	134.210	9.307	7.914	73.650	28
29	15.863	.0630	.00673	.1067	148.631	9.370	8.049	75.415	29
30	17.449	.0573	.00608	.1061	164.494	9.427	8.176	77.077	30
31	19.194	.0521	.00550	.1055	181.944	9.479	8.296	78.640	31
32	21.114	.0474	.00497	.1050	201.138	9.526	8.409	80.108	32
33	23.225	.0431	.00450	.1045	222.252	9.569	8.515	81.486	33
34	25.548	.0391	.00407	.1041	245.477	9.609	8.615	82.777	34
35	28.102	.0356	.00369	.1037	271.025	9.644	8.709	83.987	35
40	45.259	.0221	.00226	.1023	442.593	9.779	9.096	88.953	40
45	72.891	.0137	.00139	.1014	718.905	9.863	9.374	92.454	45
50	117.391	.00852	.00086	.1009	1 163.9	9.915	9.570	94.889	50
55	189.059	.00529	.00053	.1005	1 880.6	9.947	9.708	96.562	55
60	304.482	.00328	.00033	.1003	3 034.8	9.967	9.802	97.701	60
65	490.371	.00204	.00020	.1002	4 893.7	9.980	9.867	98.471	65
70	789.748	.00127	.00013	.1001	7 887.5	9.987	9.911	98.987	70
75	1 271.9	.00079	.00008	.1001	12 709.0	9.992	9.941	99.332	75
80	2 048.4	.00049	.00005	.1000	20 474.0	9.995	9.961	99.561	80
85	3 299.0	.00030	.00003	.1000	32 979.7	9.997	9.974	99.712	85
90	5 313.0	.00019	.00002	.1000	53 120.3	9.998	9.983	99.812	90
95	8 556.7	.00012	.00001	.1000	85 556.9	9.999	9.989	99.877	95
100	13 780.6	.00007	.00001	.1000	137 796.3	9.999	9.993	99.920	100

12%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.120	.8929	1.0000	1.1200	1.000	0.893	0	0	1
2	1.254	.7972	.4717	.5917	2.120	1.690	0.472	0.797	2
3	1.405	.7118	.2963	.4163	3.374	2.402	0.925	2.221	3
4	1.574	.6355	.2092	.3292	4.779	3.037	1.359	4.127	4
5	1.762	.5674	.1574	.2774	6.353	3.605	1.775	6.397	5
6	1.974	.5066	.1232	.2432	8.115	4.111	2.172	8.930	6
7	2.211	.4523	.0991	.2191	10.089	4.564	2.551	11.644	7
8	2.476	.4039	.0813	.2013	12.300	4.968	2.913	14.471	8
9	2.773	.3606	.0677	.1877	14.776	5.328	3.257	17.356	9
10	3.106	.3220	.0570	.1770	17.549	5.650	3.585	20.254	10
11	3.479	.2875	.0484	.1684	20.655	5.938	3.895	23.129	11
12	3.896	.2567	.0414	.1614	24.133	6.194	4.190	25.952	12
13	4.363	.2292	.0357	.1557	28.029	6.424	4.466	28.702	13
14	4.887	.2046	.0309	.1509	32.393	6.628	4.732	31.362	14
15	5.474	.1827	.0268	.1468	37.280	6.811	4.980	33.920	15
16	6.130	.1631	.0234	.1434	42.753	6.974	5.215	36.367	16
17	6.866	.1456	.0205	.1405	48.884	7.120	5.435	38.697	17
18	7.690	.1300	.0179	.1379	55.750	7.250	5.643	40.908	18
19	8.613	.1161	.0158	.1358	63.440	7.366	5.838	42.998	19
20	9.646	.1037	.0139	.1339	72.052	7.469	6.020	44.968	20
21	10.804	.0926	.0122	.1322	81.699	7.562	6.191	46.819	21
22	12.100	.0826	.0108	.1308	92.503	7.645	6.351	48.554	22
23	13.552	.0738	.00956	.1296	104.603	7.718	6.501	50.178	23
24	15.179	.0659	.00846	.1285	118.155	7.784	6.641	51.693	24
25	17.000	.0588	.00750	.1275	133.334	7.843	6.771	53.105	25
26	19.040	.0525	.00665	.1267	150.334	7.896	6.892	54.418	26
27	21.325	.0469	.00590	.1259	169.374	7.943	7.005	55.637	27
28	23.884	.0419	.00524	.1252	190.699	7.984	7.110	56.767	28
29	26.750	.0374	.00466	.1247	214.583	8.022	7.207	57.814	29
30	29.960	.0334	.00414	.1241	241.333	8.055	7.299	58.782	30
31	33.555	.0298	.00369	.1237	271.293	8.085	7.381	59.676	31
32	37.582	.0266	.00328	.1233	304.848	8.112	7.459	60.501	32
33	42.092	.0238	.00292	.1229	342.429	8.135	7.530	61.261	33
34	47.143	.0212	.00260	.1226	384.521	8.157	7.596	61.961	34
35	52.800	.0189	.00232	.1223	431.663	8.176	7.655	62.605	35
40	93.051	.0107	.00130	.1213	767.091	8.244	7.899	65.116	40
45	163.988	.00610	.00074	.1207	1 358.2	8.283	8.057	66.734	45
50	289.002	.00346	.00042	.1204	2 400.0	8.304	8.160	67.762	50
55	509.321	.00196	.00024	.1202	4 236.0	8.317	8.225	68.408	55
60	897.597	.00111	.00013	.1201	7 471.6	8.324	8.266	68.810	60
65	1581.9	.00063	.00008	.1201	13 173.9	8.328	8.292	69.058	65
70	2787.8	.00036	.00004	.1200	23 223.3	8.330	8.308	69.210	70
75	4913.1	.00020	.00002	.1200	40 933.8	8.332	8.318	69.303	75
80	8658.5	.00012	.00001	.1200	72 145.7	8.332	8.324	69.359	80
85	15259.2	.00007	.00001	.1200	127 151.7	8.333	8.328	69.393	85
90	26891.9	.00004		.1200	224 091.1	8.333	8.330	69.414	90
95	47392.8	.00002		.1200	394 931.4	8.333	8.331	69.426	95
100	83522.3	.00001		.1200	696 010.5	8.333	8.332	69.434	100

Compound Interest Factors — 15%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
n	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	n
1	1.150	.8696	1.0000	1.1500	1.000	0.870	0	0	1
2	1.322	.7561	.4651	.6151	2.150	1.626	0.465	0.756	2
3	1.521	.6575	.2880	.4380	3.472	2.283	0.907	2.071	3
4	1.749	.5718	.2003	.3503	4.993	2.855	1.326	3.786	4
5	2.011	.4972	.1483	.2983	6.742	3.352	1.723	5.775	5
6	2.313	.4323	.1142	.2642	8.754	3.784	2.097	7.937	6
7	2.660	.3759	.0904	.2404	11.067	4.160	2.450	10.192	7
8	3.059	.3269	.0729	.2229	13.727	4.487	2.781	12.481	8
9	3.518	.2843	.0596	.2096	16.786	4.772	3.092	14.755	9
10	4.046	.2472	.0493	.1993	20.304	5.019	3.383	16.979	10
11	4.652	.2149	.0411	.1911	24.349	5.234	3.655	19.129	11
12	5.350	.1869	.0345	.1845	29.002	5.421	3.908	21.185	12
13	6.153	.1625	.0291	.1791	34.352	5.583	4.144	23.135	13
14	7.076	.1413	.0247	.1747	40.505	5.724	4.362	24.972	14
15	8.137	.1229	.0210	.1710	47.580	5.847	4.565	26.693	15
16	9.358	.1069	.0179	.1679	55.717	5.954	4.752	28.296	16
17	10.761	.0929	.0154	.1654	65.075	6.047	4.925	29.783	17
18	12.375	.0808	.0132	.1632	75.836	6.128	5.084	31.156	18
19	14.232	.0703	.0113	.1613	88.212	6.198	5.231	32.421	19
20	16.367	.0611	.00976	.1598	102.444	6.259	5.365	33.582	20
21	18.822	.0531	.00842	.1584	118.810	6.312	5.488	34.645	21
22	21.645	.0462	.00727	.1573	137.632	6.359	5.601	35.615	22
23	24.891	.0402	.00628	.1563	159.276	6.399	5.704	36.499	23
24	28.625	.0349	.00543	.1554	184.168	6.434	5.798	37.302	24
25	32.919	.0304	.00470	.1547	212.793	6.464	5.883	38.031	25
26	37.857	.0264	.00407	.1541	245.712	6.491	5.961	38.692	26
27	43.535	.0230	.00353	.1535	283.569	6.514	6.032	39.289	27
28	50.066	.0200	.00306	.1531	327.104	6.534	6.096	39.828	28
29	57.575	.0174	.00265	.1527	377.170	6.551	6.154	40.315	29
30	66.212	.0151	.00230	.1523	434.745	6.566	6.207	40.753	30
31	76.144	.0131	.00200	.1520	500.957	6.579	6.254	41.147	31
32	87.565	.0114	.00173	.1517	577.100	6.591	6.297	41.501	32
33	100.700	.00993	.00150	.1515	664.666	6.600	6.336	41.818	33
34	115.805	.00864	.00131	.1513	765.365	6.609	6.371	42.103	34
35	133.176	.00751	.00113	.1511	881.170	6.617	6.402	42.359	35
40	267.864	.00373	.00056	.1506	1779.1	6.642	6.517	43.283	40
45	538.769	.00186	.00028	.1503	3585.1	6.654	6.583	43.805	45
50	1083.7	.00092	.00014	.1501	7217.7	6.661	6.620	44.096	50
55	2179.6	.00046	.00007	.1501	14524.1	6.664	6.641	44.256	55
60	4384.0	.00023	.00003	.1500	29220.0	6.665	6.653	44.343	60
65	8817.8	.00011	.00002	.1500	58778.6	6.666	6.659	44.390	65
70	17735.7	.00006	.00001	.1500	118231.5	6.666	6.663	44.416	70
75	35672.9	.00003		.1500	237812.5	6.666	6.665	44.429	75
80	71750.9	.00001		.1500	478332.6	6.667	6.666	44.436	80
85	144316.7	.00001		.1500	962104.4	6.667	6.666	44.440	85

Compound Interest Factors — 18%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
n	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	n
1	1.180	.8475	1.0000	1.1800	1.000	0.847	0	0	1
2	1.392	.7182	.4587	.6387	2.180	1.566	0.459	0.718	2
3	1.643	.6086	.2799	.4599	3.572	2.174	0.890	1.935	3
4	1.939	.5158	.1917	.3717	5.215	2.690	1.295	3.483	4
5	2.288	.4371	.1398	.3198	7.154	3.127	1.673	5.231	5
6	2.700	.3704	.1059	.2859	9.442	3.498	2.025	7.083	6
7	3.185	.3139	.0824	.2624	12.142	3.812	2.353	8.967	7
8	3.759	.2660	.0652	.2452	15.327	4.078	2.656	10.829	8
9	4.435	.2255	.0524	.2324	19.086	4.303	2.936	12.633	9
10	5.234	.1911	.0425	.2225	23.521	4.494	3.194	14.352	10
11	6.176	.1619	.0348	.2148	28.755	4.656	3.430	15.972	11
12	7.288	.1372	.0286	.2086	34.931	4.793	3.647	17.481	12
13	8.599	.1163	.0237	.2037	42.219	4.910	3.845	18.877	13
14	10.147	.0985	.0197	.1997	50.818	5.008	4.025	20.158	14
15	11.974	.0835	.0164	.1964	60.965	5.092	4.189	21.327	15
16	14.129	.0708	.0137	.1937	72.939	5.162	4.337	22.389	16
17	16.672	.0600	.0115	.1915	87.068	5.222	4.471	23.348	17
18	19.673	.0508	.00964	.1896	103.740	5.273	4.592	24.212	18
19	23.214	.0431	.00810	.1881	123.413	5.316	4.700	24.988	19
20	27.393	.0365	.00682	.1868	146.628	5.353	4.798	25.681	20
21	32.324	.0309	.00575	.1857	174.021	5.384	4.885	26.300	21
22	38.142	.0262	.00485	.1848	206.345	5.410	4.963	26.851	22
23	45.008	.0222	.00409	.1841	244.487	5.432	5.033	27.339	23
24	53.109	.0188	.00345	.1835	289.494	5.451	5.095	27.772	24
25	62.669	.0160	.00292	.1829	342.603	5.467	5.150	28.155	25
26	73.949	.0135	.00247	.1825	405.272	5.480	5.199	28.494	26
27	87.260	.0115	.00209	.1821	479.221	5.492	5.243	28.791	27
28	102.966	.00971	.00177	.1818	566.480	5.502	5.281	29.054	28
29	121.500	.00823	.00149	.1815	669.447	5.510	5.315	29.284	29
30	143.370	.00697	.00126	.1813	790.947	5.517	5.345	29.486	30
31	169.177	.00591	.00107	.1811	934.317	5.523	5.371	29.664	31
32	199.629	.00501	.00091	.1809	1103.5	5.528	5.394	29.819	32
33	235.562	.00425	.00077	.1808	1303.1	5.532	5.415	29.955	33
34	277.963	.00360	.00065	.1806	1538.7	5.536	5.433	30.074	34
35	327.997	.00305	.00055	.1806	1816.6	5.539	5.449	30.177	35
40	750.377	.00133	.00024	.1802	4163.2	5.548	5.502	30.527	40
45	1716.7	.00058	.00010	.1801	9531.6	5.552	5.529	30.701	45
50	3927.3	.00025	.00005	.1800	21813.0	5.554	5.543	30.786	50
55	8984.8	.00011	.00002	.1800	49910.1	5.555	5.549	30.827	55
60	20555.1	.00005	.00001	.1800	114189.4	5.555	5.553	30.846	60
65	47025.1	.00002		.1800	261244.7	5.555	5.554	30.856	65
70	107581.9	.00001		.1800	597671.7	5.556	5.555	30.860	70

25%

Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	
1	1.250	.8000	1.0000	1.2500	1.000	0.800	0	0	1
2	1.563	.6400	.4444	.6944	2.250	1.440	0.444	0.640	2
3	1.953	.5120	.2623	.5123	3.813	1.952	0.852	1.664	3
4	2.441	.4096	.1734	.4234	5.766	2.362	1.225	2.893	4
5	3.052	.3277	.1218	.3718	8.207	2.689	1.563	4.204	5
6	3.815	.2621	.0888	.3388	11.259	2.951	1.868	5.514	6
7	4.768	.2097	.0663	.3163	15.073	3.161	2.142	6.773	7
8	5.960	.1678	.0504	.3004	19.842	3.329	2.387	7.947	8
9	7.451	.1342	.0388	.2888	25.802	3.463	2.605	9.021	9
10	9.313	.1074	.0301	.2801	33.253	3.571	2.797	9.987	10
11	11.642	.0859	.0235	.2735	42.566	3.656	2.966	10.846	11
12	14.552	.0687	.0184	.2684	54.208	3.725	3.115	11.602	12
13	18.190	.0550	.0145	.2645	68.760	3.780	3.244	12.262	13
14	22.737	.0440	.0115	.2615	86.949	3.824	3.356	12.833	14
15	28.422	.0352	.00912	.2591	109.687	3.859	3.453	13.326	15
16	35.527	.0281	.00724	.2572	138.109	3.887	3.537	13.748	16
17	44.409	.0225	.00576	.2558	173.636	3.910	3.608	14.108	17
18	55.511	.0180	.00459	.2546	218.045	3.928	3.670	14.415	18
19	69.389	.0144	.00366	.2537	273.556	3.942	3.722	14.674	19
20	86.736	.0115	.00292	.2529	342.945	3.954	3.767	14.893	20
21	108.420	.00922	.00233	.2523	429.681	3.963	3.805	15.078	21
22	135.525	.00738	.00186	.2519	538.101	3.970	3.836	15.233	22
23	169.407	.00590	.00148	.2515	673.626	3.976	3.863	15.362	23
24	211.758	.00472	.00119	.2512	843.033	3.981	3.886	15.471	24
25	264.698	.00378	.00095	.2509	1054.8	3.985	3.905	15.562	25
26	330.872	.00302	.00076	.2508	1319.5	3.988	3.921	15.637	26
27	413.590	.00242	.00061	.2506	1650.4	3.990	3.935	15.700	27
28	516.988	.00193	.00048	.2505	2064.0	3.992	3.946	15.752	28
29	646.235	.00155	.00039	.2504	2580.9	3.994	3.955	15.796	29
30	807.794	.00124	.00031	.2503	3227.2	3.995	3.963	15.832	30
31	1009.7	.00099	.00025	.2502	4035.0	3.996	3.969	15.861	31
32	1262.2	.00079	.00020	.2502	5044.7	3.997	3.975	15.886	32
33	1577.7	.00063	.00016	.2502	6306.9	3.997	3.979	15.906	33
34	1972.2	.00051	.00013	.2501	7884.6	3.998	3.983	15.923	34
35	2465.2	.00041	.00010	.2501	9856.8	3.998	3.986	15.937	35
40	7523.2	.00013	.00003	.2500	30088.7	3.999	3.995	15.977	40
45	22958.9	.00004	.00001	.2500	91831.5	4.000	3.998	15.991	45
50	70064.9	.00001		.2500	280255.7	4.000	3.999	15.997	50
55	213821.2			.2500	855280.7	4.000	4.000	15.999	55

25%

Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
n	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	n
1	1.250	.8000	1.0000	1.2500	1.000	0.800	0	0	1
2	1.563	.6400	.4444	.6944	2.250	1.440	0.444	0.640	2
3	1.953	.5120	.2623	.5123	3.813	1.952	0.852	1.664	3
4	2.441	.4096	.1734	.4234	5.766	2.362	1.225	2.893	4
5	3.052	.3277	.1218	.3718	8.207	2.689	1.563	4.204	5
6	3.815	.2621	.0888	.3388	11.259	2.951	1.868	5.514	6
7	4.768	.2097	.0663	.3163	15.073	3.161	2.142	6.773	7
8	5.960	.1678	.0504	.3004	19.842	3.329	2.387	7.947	8
9	7.451	.1342	.0388	.2888	25.802	3.463	2.605	9.021	9
10	9.313	.1074	.0301	.2801	33.253	3.571	2.797	9.987	10
11	11.642	.0859	.0235	.2735	42.566	3.656	2.966	10.846	11
12	14.552	.0687	.0184	.2684	54.208	3.725	3.115	11.602	12
13	18.190	.0550	.0145	.2645	68.760	3.780	3.244	12.262	13
14	22.737	.0440	.0115	.2615	86.949	3.824	3.356	12.833	14
15	28.422	.0352	.00912	.2591	109.687	3.859	3.453	13.326	15
16	35.527	.0281	.00724	.2572	138.109	3.887	3.537	13.748	16
17	44.409	.0225	.00576	.2558	173.636	3.910	3.608	14.108	17
18	55.511	.0180	.00459	.2546	218.045	3.928	3.670	14.415	18
19	69.389	.0144	.00366	.2537	273.556	3.942	3.722	14.674	19
20	86.736	.0115	.00292	.2529	342.945	3.954	3.767	14.893	20
21	108.420	.00922	.00233	.2523	429.681	3.963	3.805	15.078	21
22	135.525	.00738	.00186	.2519	538.101	3.970	3.836	15.233	22
23	169.407	.00590	.00148	.2515	673.626	3.976	3.863	15.362	23
24	211.758	.00472	.00119	.2512	843.033	3.981	3.886	15.471	24
25	264.698	.00378	.00095	.2509	1054.8	3.985	3.905	15.562	25
26	330.872	.00302	.00076	.2508	1319.5	3.988	3.921	15.637	26
27	413.590	.00242	.00061	.2506	1650.4	3.990	3.935	15.700	27
28	516.988	.00193	.00048	.2505	2064.0	3.992	3.946	15.752	28
29	646.235	.00155	.00039	.2504	2580.9	3.994	3.955	15.796	29
30	807.794	.00124	.00031	.2503	3227.2	3.995	3.963	15.832	30
31	1009.7	.00099	.00025	.2502	4035.0	3.996	3.969	15.861	31
32	1262.2	.00079	.00020	.2502	5044.7	3.997	3.975	15.886	32
33	1577.7	.00063	.00016	.2502	6306.9	3.997	3.979	15.906	33
34	1972.2	.00051	.00013	.2501	7884.6	3.998	3.983	15.923	34
35	2465.2	.00041	.00010	.2501	9856.8	3.998	3.986	15.937	35
40	7523.2	.00013	.00003	.2500	30088.7	3.999	3.995	15.977	40
45	22958.9	.00004	.00001	.2500	91831.5	4.000	3.998	15.991	45
50	70064.9	.00001		.2500	280255.7	4.000	3.999	15.997	50
55	213821.2			.2500	855280.7	4.000	4.000	15.999	55

30%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.300	.7692	1.0000	1.3000	1.000	0.769	0	0	1
2	1.690	.5917	.4348	.7348	2.300	1.361	0.435	0.592	2
3	2.197	.4552	.2506	.5506	3.990	1.816	0.827	1.502	3
4	2.856	.3501	.1616	.4616	6.187	2.166	1.178	2.552	4
5	3.713	.2693	.1106	.4106	9.043	2.436	1.490	3.630	5
6	4.827	.2072	.0784	.3784	12.756	2.643	1.765	4.666	6
7	6.275	.1594	.0569	.3569	17.583	2.802	2.006	5.622	7
8	8.157	.1226	.0419	.3419	23.858	2.925	2.216	6.480	8
9	10.604	.0943	.0312	.3312	32.015	3.019	2.396	7.234	9
10	13.786	.0725	.0235	.3235	42.619	3.092	2.551	7.887	10
11	17.922	.0558	.0177	.3177	56.405	3.147	2.683	8.445	11
12	23.298	.0429	.0135	.3135	74.327	3.190	2.795	8.917	12
13	30.287	.0330	.0102	.3102	97.625	3.223	2.889	9.314	13
14	39.374	.0254	.00782	.3078	127.912	3.249	2.969	9.644	14
15	51.186	.0195	.00598	.3060	167.286	3.268	3.034	9.917	15
16	66.542	.0150	.00458	.3046	218.472	3.283	3.089	10.143	16
17	86.504	.0116	.00351	.3035	285.014	3.295	3.135	10.328	17
18	112.455	.00889	.00269	.3027	371.518	3.304	3.172	10.479	18
19	146.192	.00684	.00207	.3021	483.973	3.311	3.202	10.602	19
20	190.049	.00526	.00159	.3016	630.165	3.316	3.228	10.702	20
21	247.064	.00405	.00122	.3012	820.214	3.320	3.248	10.783	21
22	321.184	.00311	.00094	.3009	1067.3	3.323	3.265	10.848	22
23	417.539	.00239	.00072	.3007	1388.5	3.325	3.278	10.901	23
24	542.800	.00184	.00055	.3006	1806.0	3.327	3.289	10.943	24
25	705.640	.00142	.00043	.3004	2348.8	3.329	3.298	10.977	25
26	917.332	.00109	.00033	.3003	3054.4	3.330	3.305	11.005	26
27	1192.5	.00084	.00025	.3003	3971.8	3.331	3.311	11.026	27
28	1550.3	.00065	.00019	.3002	5164.3	3.331	3.315	11.044	28
29	2015.4	.00050	.00015	.3001	6714.6	3.332	3.319	11.058	29
30	2620.0	.00038	.00011	.3001	8730.0	3.332	3.322	11.069	30
31	3406.0	.00029	.00009	.3001	11350.0	3.332	3.324	11.078	31
32	4427.8	.00023	.00007	.3001	14756.0	3.333	3.326	11.085	32
33	5756.1	.00017	.00005	.3001	19183.7	3.333	3.328	11.090	33
34	7483.0	.00013	.00004	.3000	24939.9	3.333	3.329	11.094	34
35	9727.8	.00010	.00003	.3000	32422.8	3.333	3.330	11.098	35
40	36118.8	.00003	.00001	.3000	120392.6	3.333	3.332	11.107	40
45	134106.5	.00001		.3000	447018.3	3.333	3.333	11.110	45

35%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.350	.7407	1.0000	1.3500	1.000	0.741	0	0	1
2	1.822	.5487	.4255	.7755	2.350	1.289	0.426	0.549	2
3	2.460	.4064	.2397	.5897	4.173	1.696	0.803	1.362	3
4	3.322	.3011	.1508	.5008	6.633	1.997	1.134	2.265	4
5	4.484	.2230	.1005	.4505	9.954	2.220	1.422	3.157	5
6	6.053	.1652	.0693	.4193	14.438	2.385	1.670	3.983	6
7	8.172	.1224	.0488	.3988	20.492	2.508	1.881	4.717	7
8	11.032	.0906	.0349	.3849	28.664	2.598	2.060	5.352	8
9	14.893	.0671	.0252	.3752	39.696	2.665	2.209	5.889	9
10	20.107	.0497	.0183	.3683	54.590	2.715	2.334	6.336	10
11	27.144	.0368	.0134	.3634	74.697	2.752	2.436	6.705	11
12	36.644	.0273	.00982	.3598	101.841	2.779	2.520	7.005	12
13	49.470	.0202	.00722	.3572	138.485	2.799	2.589	7.247	13
14	66.784	.0150	.00532	.3553	187.954	2.814	2.644	7.442	14
15	90.158	.0111	.00393	.3539	254.739	2.825	2.689	7.597	15
16	121.714	.00822	.00290	.3529	344.897	2.834	2.725	7.721	16
17	164.314	.00609	.00214	.3521	466.611	2.840	2.753	7.818	17
18	221.824	.00451	.00158	.3516	630.925	2.844	2.776	7.895	18
19	299.462	.00334	.00117	.3512	852.748	2.848	2.793	7.955	19
20	404.274	.00247	.00087	.3509	1152.2	2.850	2.808	8.002	20
21	545.769	.00183	.00064	.3506	1556.5	2.852	2.819	8.038	21
22	736.789	.00136	.00048	.3505	2102.3	2.853	2.827	8.067	22
23	994.665	.00101	.00035	.3504	2839.0	2.854	2.834	8.089	23
24	1342.8	.00074	.00026	.3503	3833.7	2.855	2.839	8.106	24
25	1812.8	.00055	.00019	.3502	5176.5	2.856	2.843	8.119	25
26	2447.2	.00041	.00014	.3501	6989.3	2.856	2.847	8.130	26
27	3303.8	.00030	.00011	.3501	9436.5	2.856	2.849	8.137	27
28	4460.1	.00022	.00008	.3501	12740.3	2.857	2.851	8.143	28
29	6021.1	.00017	.00006	.3501	17200.4	2.857	2.852	8.148	29
30	8128.5	.00012	.00004	.3500	23221.6	2.857	2.853	8.152	30
31	10973.5	.00009	.00003	.3500	31350.1	2.857	2.854	8.154	31
32	14814.3	.00007	.00002	.3500	42323.7	2.857	2.855	8.157	32
33	19999.3	.00005	.00002	.3500	57137.9	2.857	2.855	8.158	33
34	26999.0	.00004	.00001	.3500	77137.2	2.857	2.856	8.159	34
35	36448.7	.00003	.00001	.3500	104136.3	2.857	2.856	8.160	35

40%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.400	.7143	1.0000	1.4000	1.000	0.714	0	0	1
2	1.960	.5102	.4167	.8167	2.400	1.224	0.417	0.510	2
3	2.744	.3644	.2294	.6294	4.360	1.589	0.780	1.239	3
4	3.842	.2603	.1408	.5408	7.104	1.849	1.092	2.020	4
5	5.378	.1859	.0914	.4914	10.946	2.035	1.358	2.764	5
6	7.530	.1328	.0613	.4613	16.324	2.168	1.581	3.428	6
7	10.541	.0949	.0419	.4419	23.853	2.263	1.766	3.997	7
8	14.758	.0678	.0291	.4291	34.395	2.331	1.919	4.471	8
9	20.661	.0484	.0203	.4203	49.153	2.379	2.042	4.858	9
10	28.925	.0346	.0143	.4143	69.814	2.414	2.142	5.170	10
11	40.496	.0247	.0101	.4101	98.739	2.438	2.221	5.417	11
12	56.694	.0176	.00718	.4072	139.235	2.456	2.285	5.611	12
13	79.371	.0126	.00510	.4051	195.929	2.469	2.334	5.762	13
14	111.120	.00900	.00363	.4036	275.300	2.478	2.373	5.879	14
15	155.568	.00643	.00259	.4026	386.420	2.484	2.403	5.969	15
16	217.795	.00459	.00185	.4018	541.988	2.489	2.426	6.038	16
17	304.913	.00328	.00132	.4013	759.783	2.492	2.444	6.090	17
18	426.879	.00234	.00094	.4009	1064.7	2.494	2.458	6.130	18
19	597.630	.00167	.00067	.4007	1419.6	2.496	2.468	6.160	19
20	836.682	.00120	.00048	.4005	2089.2	2.497	2.476	6.183	20
21	1171.4	.00085	.00034	.4003	2925.9	2.498	2.482	6.200	21
22	1639.9	.00061	.00024	.4002	4097.2	2.498	2.487	6.213	22
23	2295.9	.00044	.00017	.4002	5737.1	2.499	2.490	6.222	23
24	3214.2	.00031	.00012	.4001	8033.0	2.499	2.493	6.229	24
25	4499.9	.00022	.00009	.4001	11247.2	2.499	2.494	6.235	25
26	6299.8	.00016	.00006	.4001	15747.1	2.500	2.496	6.239	26
27	8819.8	.00011	.00005	.4000	22046.9	2.500	2.497	6.242	27
28	12347.7	.00008	.00003	.4000	30866.7	2.500	2.498	6.244	28
29	17286.7	.00006	.00002	.4000	43214.3	2.500	2.498	6.245	29
30	24201.4	.00004	.00002	.4000	60501.0	2.500	2.499	6.247	30
31	33882.0	.00003	.00001	.4000	84702.5	2.500	2.499	6.248	31
32	47434.8	.00002	.00001	.4000	118584.4	2.500	2.499	6.248	32
33	66408.7	.00002	.00001	.4000	166019.2	2.500	2.500	6.249	33
34	92972.1	.00001		.4000	232427.9	2.500	2.500	6.249	34
35	130161.0	.00001		.4000	325400.0	2.500	2.500	6.249	35

45%

Compound Interest Factors

n	Single Payment: Compound Amount Factor Find F Given P F/P	Single Payment: Present Worth Factor Find P Given F P/F	Uniform Payment Series: Sinking Fund Factor Find A Given F A/F	Uniform Payment Series: Capital Recovery Factor Find A Given P A/P	Uniform Payment Series: Compound Amount Factor Find F Given A F/A	Uniform Payment Series: Present Worth Factor Find P Given A P/A	Arithmetic Gradient: Gradient Uniform Series Find A Given G A/G	Arithmetic Gradient: Gradient Present Worth Find P Given G P/G	n
1	1.450	.6897	1.0000	1.4500	1.000	0.690	0	0	1
2	2.103	.4756	.4082	.8582	2.450	1.165	0.408	0.476	2
3	3.049	.3280	.2197	.6697	4.553	1.493	0.758	1.132	3
4	4.421	.2262	.1316	.5816	7.601	1.720	1.053	1.810	4
5	6.410	.1560	.0832	.5332	12.022	1.876	1.298	2.434	5
6	9.294	.1076	.0543	.5043	18.431	1.983	1.499	2.972	6
7	13.476	.0742	.0361	.4861	27.725	2.057	1.661	3.418	7
8	19.541	.0512	.0243	.4743	41.202	2.109	1.791	3.776	8
9	28.334	.0353	.0165	.4665	60.743	2.144	1.893	4.058	9
10	41.085	.0243	.0112	.4612	89.077	2.168	1.973	4.277	10
11	59.573	.0168	.00768	.4577	130.162	2.185	2.034	4.445	11
12	86.381	.0116	.00527	.4553	189.735	2.196	2.082	4.572	12
13	125.252	.00798	.00362	.4536	276.115	2.204	2.118	4.668	13
14	181.615	.00551	.00249	.4525	401.367	2.210	2.145	4.740	14
15	263.342	.00380	.00172	.4517	582.982	2.214	2.165	4.793	15
16	381.846	.00262	.00118	.4512	846.325	2.216	2.180	4.832	16
17	553.677	.00181	.00081	.4508	1228.2	2.218	2.191	4.861	17
18	802.831	.00125	.00056	.4506	1781.8	2.219	2.200	4.882	18
19	1164.1	.00086	.00039	.4504	2584.7	2.220	2.206	4.898	19
20	1688.0	.00059	.00027	.4503	3748.8	2.221	2.210	4.909	20
21	2447.5	.00041	.00018	.4502	5436.7	2.221	2.214	4.917	21
22	3548.9	.00028	.00013	.4501	7884.3	2.222	2.216	4.923	22
23	5145.9	.00019	.00009	.4501	11433.2	2.222	2.218	4.927	23
24	7461.6	.00013	.00006	.4501	16579.1	2.222	2.219	4.930	24
25	10819.3	.00009	.00004	.4500	24040.7	2.222	2.220	4.933	25
26	15688.0	.00006	.00003	.4500	34860.1	2.222	2.221	4.934	26
27	22747.7	.00004	.00002	.4500	50548.1	2.222	2.221	4.935	27
28	32984.1	.00003	.00001	.4500	73295.8	2.222	2.221	4.936	28
29	47826.9	.00002	.00001	.4500	106279.9	2.222	2.222	4.937	29
30	69349.1	.00001	.00001	.4500	154106.8	2.222	2.222	4.937	30
31	100556.1	.00001		.4500	223455.9	2.222	2.222	4.938	31
32	145806.4	.00001		.4500	324012.0	2.222	2.222	4.938	32
33	211419.3			.4500	469818.5	2.222	2.222	4.938	33
34	306558.0			.4500	681237.8	2.222	2.222	4.938	34
35	444509.2			.4500	987795.9	2.222	2.222	4.938	35

Compound Interest Factors — 50%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	n
1	1.500	.6667	1.0000	1.5000	1.000	0.667	0	0	1
2	2.250	.4444	.4000	.9000	2.500	1.111	0.400	0.444	2
3	3.375	.2963	.2105	.7105	4.750	1.407	0.737	1.037	3
4	5.063	.1975	.1231	.6231	8.125	1.605	1.015	1.630	4
5	7.594	.1317	.0758	.5758	13.188	1.737	1.242	2.156	5
6	11.391	.0878	.0481	.5481	20.781	1.824	1.423	2.595	6
7	17.086	.0585	.0311	.5311	32.172	1.883	1.565	2.947	7
8	25.629	.0390	.0203	.5203	49.258	1.922	1.675	3.220	8
9	38.443	.0260	.0134	.5134	74.887	1.948	1.760	3.428	9
10	57.665	.0173	.00882	.5088	113.330	1.965	1.824	3.584	10
11	86.498	.0116	.00585	.5058	170.995	1.977	1.871	3.699	11
12	129.746	.00771	.00388	.5039	257.493	1.985	1.907	3.784	12
13	194.620	.00514	.00258	.5026	387.239	1.990	1.933	3.846	13
14	291.929	.00343	.00172	.5017	581.859	1.993	1.952	3.890	14
15	437.894	.00228	.00114	.5011	873.788	1.995	1.966	3.922	15
16	656.814	.00152	.00076	.5008	1311.7	1.997	1.976	3.945	16
17	985.261	.00101	.00051	.5005	1968.5	1.998	1.983	3.961	17
18	1477.9	.00068	.00034	.5003	2953.8	1.999	1.988	3.973	18
19	2216.8	.00045	.00023	.5002	4431.7	1.999	1.991	3.981	19
20	3325.3	.00030	.00015	.5002	6648.5	1.999	1.994	3.987	20
21	4987.9	.00020	.00010	.5001	9973.8	2.000	1.996	3.991	21
22	7481.8	.00013	.00007	.5001	14961.7	2.000	1.997	3.994	22
23	11222.7	.00009	.00004	.5000	22443.5	2.000	1.998	3.996	23
24	16834.1	.00006	.00003	.5000	33666.2	2.000	1.999	3.997	24
25	25251.2	.00004	.00002	.5000	50500.3	2.000	1.999	3.998	25
26	37876.8	.00003	.00001	.5000	75751.5	2.000	1.999	3.999	26
27	56815.1	.00002	.00001	.5000	113628.3	2.000	2.000	3.999	27
28	85222.7	.00001	.00001	.5000	170443.4	2.000	2.000	3.999	28
29	127834.0	.00001		.5000	255666.1	2.000	2.000	4.000	29
30	191751.1	.00001		.5000	383500.1	2.000	2.000	4.000	30
31	287626.6			.5000	575251.2	2.000	2.000	4.000	31
32	431439.9			.5000	862877.8	2.000	2.000	4.000	32

60% — Compound Interest Factors — 60%

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor Find F Given P F/P	Present Worth Factor Find P Given F P/F	Sinking Fund Factor Find A Given F A/F	Capital Recovery Factor Find A Given P A/P	Compound Amount Factor Find F Given A F/A	Present Worth Factor Find P Given A P/A	Gradient Uniform Series Find A Given G A/G	Gradient Present Worth Find P Given G P/G	n
1	1.600	.6250	1.0000	1.6000	1.000	0.625	0	0	1
2	2.560	.3906	.3846	.9846	2.600	1.016	0.385	0.391	2
3	4.096	.2441	.1938	.7938	5.160	1.260	0.698	0.879	3
4	6.554	.1526	.1080	.7080	9.256	1.412	0.946	1.337	4
5	10.486	.0954	.0633	.6633	15.810	1.508	1.140	1.718	5
6	16.777	.0596	.0380	.6380	26.295	1.567	1.286	2.016	6
7	26.844	.0373	.0232	.6232	43.073	1.605	1.396	2.240	7
8	42.950	.0233	.0143	.6143	69.916	1.628	1.476	2.403	8
9	68.719	.0146	.00886	.6089	112.866	1.642	1.534	2.519	9
10	109.951	.00909	.00551	.6055	181.585	1.652	1.575	2.601	10
11	175.922	.00568	.00343	.6034	291.536	1.657	1.604	2.658	11
12	281.475	.00355	.00214	.6021	467.458	1.661	1.624	2.697	12
13	450.360	.00222	.00134	.6013	748.933	1.663	1.638	2.724	13
14	720.576	.00139	.00083	.6008	1199.3	1.664	1.647	2.742	14
15	1152.9	.00087	.00052	.6005	1919.9	1.665	1.654	2.754	15
16	1844.7	.00054	.00033	.6003	3072.8	1.666	1.658	2.762	16
17	2951.5	.00034	.00020	.6002	4917.5	1.666	1.661	2.767	17
18	4722.4	.00021	.00013	.6001	7868.9	1.666	1.663	2.771	18
19	7555.8	.00013	.00008	.6001	12591.3	1.666	1.664	2.773	19
20	12089.3	.00008	.00005	.6000	20147.1	1.667	1.665	2.775	20
21	19342.8	.00005	.00003	.6000	32236.3	1.667	1.666	2.776	21
22	30948.5	.00003	.00002	.6000	51579.2	1.667	1.666	2.777	22
23	49517.6	.00002	.00001	.6000	82527.6	1.667	1.666	2.777	23
24	79228.1	.00001	.00001	.6000	132045.2	1.667	1.666	2.777	24
25	126765.0	.00001		.6000	211273.4	1.667	1.666	2.777	25
26	202824.0			.6000	338038.4	1.667	1.667	2.778	26
27	324518.4			.6000	540862.4	1.667	1.667	2.778	27
28	519229.5			.6000	865380.9	1.667	1.667	2.778	28

Continuous Compounding—Single Payment Factors

rn	Compound Amount Factor e^{rn} Find F Given P F/P	Present Worth Factor e^{-rn} Find P Find F P/F	rn	Compound Amount Factor e^{rn} Find F Given P F/P	Present Worth Factor e^{-rn} Find P Given F P/F
.01	1.0101	.9900	.51	1.6653	.6005
.02	1.0202	.9802	.52	1.6820	.5945
.03	1.0305	.9704	.53	1.6989	.5886
.04	1.0408	.9608	.54	1.7160	.5827
.05	1.0513	.9512	.55	1.7333	.5769
.06	1.0618	.9418	.56	1.7507	.5712
.07	1.0725	.9324	.57	1.7683	.5655
.08	1.0833	.9231	.58	1.7860	.5599
.09	1.0942	.9139	.59	1.8040	.5543
.10	1.1052	.9048	.60	1.8221	.5488
.11	1.1163	.8958	.61	1.8404	.5434
.12	1.1275	.8869	.62	1.8589	.5379
.13	1.1388	.8781	.63	1.8776	.5326
.14	1.1503	.8694	.64	1.8965	.5273
.15	1.1618	.8607	.65	1.9155	.5220
.16	1.1735	.8521	.66	1.9348	.5169
.17	1.1853	.8437	.67	1.9542	.5117
.18	1.1972	.8353	.68	1.9739	.5066
.19	1.2092	.8270	.69	1.9937	.5016
.20	1.2214	.8187	.70	2.0138	.4966
.21	1.2337	.8106	.71	2.0340	.4916
.22	1.2461	.8025	.72	2.0544	.4868
.23	1.2586	.7945	.73	2.0751	.4819
.24	1.2712	.7866	.74	2.0959	.4771
.25	1.2840	.7788	.75	2.1170	.4724
.26	1.2969	.7711	.76	2.1383	.4677
.27	1.3100	.7634	.77	2.1598	.4630
.28	1.3231	.7558	.78	2.1815	.4584
.29	1.3364	.7483	.79	2.2034	.4538
.30	1.3499	.7408	.80	2.2255	.4493
.31	1.3634	.7334	.81	2.2479	.4449
.32	1.3771	.7261	.82	2.2705	.4404
.33	1.3910	.7189	.83	2.2933	.4360
.34	1.4049	.7118	.84	2.3164	.4317
.35	1.4191	.7047	.85	2.3396	.4274
.36	1.4333	.6977	.86	2.3632	.4232
.37	1.4477	.6907	.87	2.3869	.4190
.38	1.4623	.6839	.88	2.4109	.4148
.39	1.4770	.6771	.89	2.4351	.4107
.40	1.4918	.6703	.90	2.4596	.4066
.41	1.5068	.6637	.91	2.4843	.4025
.42	1.5220	.6570	.92	2.5093	.3985
.43	1.5373	.6505	.93	2.5345	.3946
.44	1.5527	.6440	.94	2.5600	.3906
.45	1.5683	.6376	.95	2.5857	.3867
.46	1.5841	.6313	.96	2.6117	.3829
.47	1.6000	.6250	.97	2.6379	.3791
.48	1.6161	.6188	.98	2.6645	.3753
.49	1.6323	.6126	.99	2.6912	.3716
.50	1.6487	.6065	1.00	2.7183	.3679

CBCS SCHEME

USN | | | | | | | | | | |

15CV61

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Construction Management and Entrepreneurship

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. What are the characteristics of management? (08 Marks)
b. What are the functions of management? (08 Marks)

OR

2 a. Define : i) Duration ii) Earliest start time iii) Earliest finish Time iv) Total float. (08 Marks)

b. Draw the network from the following activity and find critical path and total project duration Ref to table 1.

Activity	Predecessors	Duration (days)
A	-	10
B	-	9
C	A	6
D	A	8
E	B	7
F	B	11
G	D, E	5

(08 Marks)

Module-2

3 a. What are the factors affecting the labour output or productivity. (08 Marks)
b. Explain the basic concepts of resource management. (08 Marks)

OR

4 a. Explain the classification of construction equipment. (08 Marks)
b. Explain the sketch excavator. (08 Marks)

Module-3

5 a. Explain the process of project quality management. (08 Marks)
b. Explain TQM (08 Marks)

OR

6 a. What are the safety precautions to prevent accidents? (08 Marks)
b. Explain workmen compensation Act and Indian factories Act. (08 Marks)

Module-4

7 a. What are the principles of engineering economy? (08 Marks)
b. Explain Time value of money. (08 Marks)

OR

8 a. Write the Assumptions made is Break Even Analysis. What are the uses of Break Even Analysis? (08 Marks)
b. Explain Break Even Chart. (08 Marks)

Module-5

9 a. What are the functions of an Entrepreneur? (08 Marks)
b. What are the stages in Entrepreneurial process? (08 Marks)

OR

10 a. What are the advantages and disadvantages of becoming an entrepreneur? (08 Marks)
b. Discuss on MSME. (08 Marks)

* * * *

Model Question Paper -1 with effect from 2020-21(CBCS Scheme)

USN | | | | | | | | | | |

Fifth Semester B.E. Degree Examination
Construction Management and Entrepreneurship

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Use of Normal Distribution Function table is permitted.

<table>
<tr><th colspan="3">Module – 1</th><th>Marks</th></tr>
<tr><td rowspan="3">Q.1</td><td>(a)</td><td>Discuss the functions of management.</td><td>8</td></tr>
<tr><td>(b)</td><td>The activity data of a project is given in the Table below:
<table>
<tr><th>Activity</th><th>Preceding Activity</th><th>Duration (Days)</th></tr>
<tr><td>X</td><td>--</td><td>5</td></tr>
<tr><td>Y</td><td>X</td><td>2</td></tr>
<tr><td>C</td><td>--</td><td>6</td></tr>
<tr><td>D</td><td>--</td><td>4</td></tr>
<tr><td>E</td><td>D</td><td>7</td></tr>
<tr><td>F</td><td>Y, C, E</td><td>3</td></tr>
</table>
Draw the network diagram, identify the critical path and Project duration using CPM.</td><td>8</td></tr>
<tr><td>(c)</td><td>Mention the limitations of Bar Chart.</td><td>4</td></tr>
<tr><td colspan="3">OR</td><td></td></tr>
<tr><td rowspan="3">Q.2</td><td>(a)</td><td>Four activities to be undertaken in series for the completion of a project are as follows:
<table>
<tr><th>Activity</th><th>Optimistic time (days)</th><th>Most likely time (days)</th><th>Pessimistic time (days)</th></tr>
<tr><td>P</td><td>8</td><td>14</td><td>22</td></tr>
<tr><td>Q</td><td>7</td><td>21</td><td>32</td></tr>
<tr><td>R</td><td>8</td><td>19</td><td>28</td></tr>
<tr><td>S</td><td>28</td><td>40</td><td>52</td></tr>
</table>
Estimate the time required at
(i) 95% probability to complete the project
(ii) 5 % probability to complete the project</td><td>10</td></tr>
<tr><td>(b)</td><td>Discuss on Autocratic and Democratic Management Styles.</td><td>4</td></tr>
<tr><td>(c)</td><td>Explain the Strategic and Operational Plans.</td><td>6</td></tr>
<tr><td colspan="3">Module – 2</td><td></td></tr>
<tr><td rowspan="3">Q.3</td><td>(a)</td><td>What are the factors affecting the labour productivity?</td><td>8</td></tr>
<tr><td>(b)</td><td>Estimate the hourly production in bulk volume (LCM) of a backhoe with bucket capacity of 0.96 cubic meters that is employed on excavation of a foundation, which is 4m deep in hard digging soil. The excavated earth is to be loaded in waiting dump trucks, placed at a swing angle of 75^0. The expected performance efficiency is 83%. Assume the ideal output of face shovel with given bucket capacity is 150 LCM. Assume and list the suitable corrections to be applied.</td><td>10</td></tr>
<tr><td>(c)</td><td>Give any four advantages of material management.</td><td>2</td></tr>
<tr><td colspan="3">OR</td><td></td></tr>
<tr><td rowspan="2">Q.4</td><td>(a)</td><td>Enumerate all the types and sub types of the different construction equipment.</td><td>10</td></tr>
<tr><td>(b)</td><td>What is Inventory Control? What are the functions of inventory control.</td><td>5</td></tr>
</table>

	(c)	The purchase value of a crawler tractor is Rs. 30,00,000/-. Its assessed resale value after using for 5 years is 10% of the delivered price. The equipment is planned to operate 2000 hours per year. Calculate its annual and hourly depreciation.	5
		Module – 3	
Q.5	(a)	Differentiate between quality control and quality assurance.	4
	(b)	Explain the safety procedures to be adopted during excavation.	8
	(c)	Discuss on the following (i) Gifts and bribes (ii) whistle blowing (iii) engineering ethics	8
		OR	
Q.6	(a)	What are the safety procedures to be adopted during drilling and blasting.	6
	(b)	Explain the TQM process in construction.	8
	(c)	Briefly write about Morals and integrity in workplace.	6
		Module – 4	
Q.7	(a)	Differentiate between micro and macro economics.	8
	(b)	An engineer has two bids for an excavator to be installed in a new building project. The details of the bids for the excavator are as follows: Engineer's estimate Bid: Bid 'A' — Initial Cost (Rupees): 10,50,000/- — Service life (years): 15 — Annual Operating & Maintenance Cost (Rupees): 60,000 Bid: Bid 'B' — Initial Cost (Rupees): 11,00,000/- — Service life (years): 15 — Annual Operating & Maintenance Cost (Rupees): 70,500 Determine which bid should be accepted, based on the present worth method of comparison assuming 18% interest rate, compounded annually.	12
		OR	
Q.8	(a)	Define the following terms related to engineering economics: (i) Present worth (ii) Future worth (iii)Annuities (iv) Salvage value	8
	(b)	The fixed costs for a company are Rs. 60,000/-. The estimated sales for the period are valued at Rs. 2,00,000/-. The variable cost per unit for the single product is Rs. 5/-. If each unit sells at Rs. 25/- and the number of units involved coincides with the expected volume of output. Construct the break even chart and determine the following: (i) The breakeven point (ii) The profit earned at a turnover of Rs. 1, 25, 000/-. (iii) Margin of safety (iv) Angle of incidence	12
		Module – 5	
Q.9	(a)	Write briefly about international entrepreneurship opportunities.	4
	(b)	Enumerate the barriers for entrepreneurship.	8
	(c)	Discuss in detail about the project report for starting a new venture.	8
		OR	
Q.10	(a)	Mention the uses of direct foreign investment.	4
	(b)	Discuss the characteristics of entrepreneur.	8
	(c)	Explain the scope and role of following agencies: i. KIADB ii. SIDBI	8

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Department of Civil Engineering

USN										

Course/Subject Title	Construction Management and Entrepreneurship	Course/Subject Code	18CV51
Semester	5th sem A Section	Scheme	CBCS – 18
Date	23-10-2020	CIE No.	1
Time	2.30-3.30 PM	Max. Marks	30

After the successful completion of the course, the students will be able to	Course Outcome Statements
CO1	Explain the construction management, planning and its scheduling by project tools
CO2	Explain the concept of resource and material management, and labour productivity
CO3	Calculate the productivity of construction equipment
CO4	Explain the quality, safety and human values for the effective construction management
CO5	Explain the principles of engineering economics by problem solving and decision making concept
CO6	Explain entrepreneurship and its role in infrastructural development

Q. No.	Questions	Marks	RBT Level	CO
	Answer any one full Question from each part			
	PART-A			
1 a)	Differentiate AOA and AON. Explain Bar chart /Gantt chart. Write its limitations	8	L2	1
1 b)	What is construction planning .List the objectives of construction planning	7	L2	1
	OR			
2 a)	Draw the network for the activities shown below and find expected duration and variance ,if the expected duration time for project is 32 days.	8	L3	1
2 b)	What are the functions of management. Explain any two of them.	7	L2	1
	PART-B			
3 a)	What is Depreciation.Formulate any one type with its merits and demerits.	8	L2	2
3 b)	List the various classification of construction equipments, explain any two	7	L1	2
	OR			
4 a)	List out the factors affecting labour output and productivity	8	L2	2
4 b)	Estimate the productivity of Dozer, excavator, grader .	7	L2	2

Activity	1-2	1-3	2-4	3-4	4-5	3-5
t_o	2	3	5	2	1	6
t_m	5	12	14	5	4	15
t_p	14	21	17	8	7	30

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Arpitha D J
20/10/2020
Course Coordinator
(Faculty In charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

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Bapuji Institute of Engineering and Technology, Davangere-577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Construction Management and Entrepreneurship	Course/Subject Code	18CV51
Semester	5th Sem.	CIE No.	1
Date	23/10/2020	Max. Marks	30

Q. No

PART - A

1a) AON → Activity on Arrow
AOA → Activity on node
} Any 3 difference with Sketch — 3 M

Explination of Bar chart with a neat Sketch — 3 M
Limitations of Bar chart over Milestone — 2 M
— 8 M

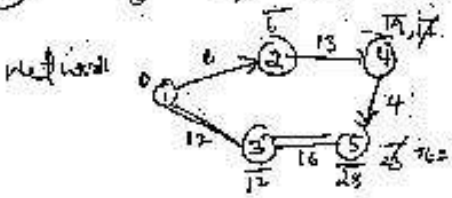
1b) Explination on Construction planning — 2 M
objectives of construction planning — 5 M
— 7 M

OR

2a)

Activity	to	tm	tp	te	St	Vt
1-2	2	5	14	6	2	4
(1-3)	3	12	21	(12)	3	(9)
2-4	5	14	17	13	2	4
3-4	2	5	8	5	1	1
4-5	1	4	7	4	1	1
(2-5)	6	15	30	(16)	4	(16)

for Cal^n → 3 M



for Network → 2 M

$T_E = 28$ $SD = 5$, $Z = 0.8$ → 3 M
— 8 M

2b) List of Management function (All five) → 2 M
Explination on Any two with an Example. 2.5 M each — 5 M
— 7 M

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Coordinator DQAC
Program Coordinator (HOD, Civil)

Scheme of Valuation

PART-B

3a) Explination & definition of deforestation — 2 M
Any one type Explination — 4 M
Merits — 1 M
Demerits — 1 M — 8 M

3b) Classification of Construction Equipment with a Chart Explination — 3 M
Explination of any two with productivity Eqn 2M each — 4 M — 7 M

4a) Factors affecting haulout output with explination — 4 M
Factors affecting productivity with Explination — 4 M — 8 M

4b) Estimation of productivity of
Dozer: $Q = q \times \frac{3600}{t} \times \text{Efficiency}$ — 3 M
q = Loose vol. haul/trip $\times s \times \frac{60}{t} \times \text{eff}$
Excavator = $q \times \frac{3600}{t} \times \text{eff}$ — 2 M
Productivity = Eff width of blade $\times$ Avg speed $\times$ Eff — 2 M
$T = \frac{\text{No of pass} \times \text{dist}}{\text{Avg speed in Rm/hr} \times \text{Effi. factor}}$ — 1 M

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Coordinator DQAC
Program Coordinator (HOD, Civil)

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Department of Civil Engineering

USN | | | | | | | | | |

Course/Subject Title	Construction Management and Entrepreneurship	Course/Subject Code	18CV51
Semester	5th sem A Section	Scheme	CBCS – 18
Date	07-12-2020	CIE No.	2
Time	9.30-10.30 PM	Max. Marks	30

Course Outcome Statements	
After the successful completion of the course, the students will be able to	
CO1	**Explain** the construction management, planning and its scheduling by project tools
CO2	**Explain** the concept of resource and material management, and labour productivity
CO3	**Calculate** the productivity of construction equipment
CO4	**Explain** the quality, safety and human values for the effective construction management
CO5	**Explain** the principles of engineering economics by problem solving and decision making concept
CO6	**Explain** entrepreneurship and its role in infrastructural development

Q. No.	Questions	Marks	RBT Level	CO
	Answer any one full Question from each part			
	PART-A			
1 a)	Explain Total Quality Management	8	L1	3
1 b)	Explain the importance of safety in construction Explain the safety measures during a)Excavation b)drilling and blasting	7	L2	3
	OR			
2 a)	Differentiate between morals and values	8	L2	3
2 b)	Describe the safety insurence.explain contractor all risk insurance	7	L3	3
	PART-B			
3 a)	Explain the concept of ownership and operating cost.	8	L2	2
3 b)	With an example, explain problem solving and decision making process.	7	L3	3
4 a)	What are the objectives of material and inventory management	8	L2	2
4 b)	Define quality. Explain the dimensions of quality	7	L2	3

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

4/12/2020
Arpitha D J
Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

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Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Construction Mgt & Entrepreneurship	Course/Subject Code	18CV51
Semester	5th Sem.	CIE No.	2
Date	7-12-2020	Max. Marks	30

PART-A

Q.NO		
1a)	Total quality Management - TQM	
	Definition → Continuous Improvement	3 M
	objectives → Customer focus, Process Improvement, Total involvement	3M
	Principles → Leadership, Education & Training, commitment; Supportive Structure, Rewards & Recognition, Measurement	2M
		8 M
1b)	Importance of Safety in Construction	2 M
	Safety measures during Excavation	2.5 M
	Safety Measures during drilling & blasting	2.5 M
		7M
	or	
2a)	Difference b/n Morals & Values Any 8 with Example 8 x 1	8M
2b)	Explanation on Safety Insurance with Example	3M
	Contractor all risk Insurance Explanation with merits and demerits.	4M

Course Coordinator (Faculty in charge) 4/12/2020

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Scheme of Valuation

PART-IB

3a) Ownership Cost : Depreciation per hour + Annual expenditure / hours used Annually

Operating cost = hourly fuel cost + Lubricating oil & other + Tyre cost + Repair Charges + Wages of operators & helpers (4h) + Cost of any special item if req. — 4M

3b) Problem Solving process, with an Explintory chart — 3M

Decision making process with Explination to the respective Example — 4M

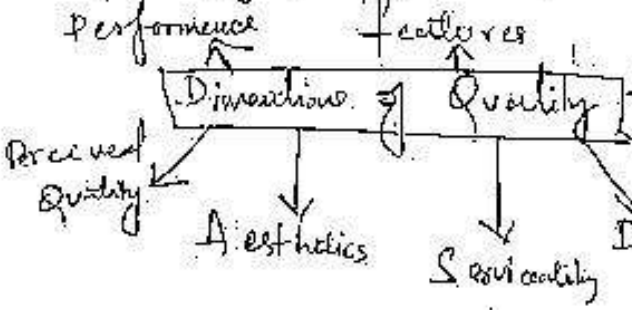
OR

4a) Objectives of Material Management Any 4 with Example for a Single Materials — 4M

objectives of Inventory Management with all formulas — 8M

4b) Quality definition (Any one Author) — 1M

Dimentions of Quality



All explinations — 6M

7M

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Department of Civil Engineering

USN

Course Subject Title	Construction Management and Entrepreneurship	Course/Subject Code	18CV51
Semester	5th sem A Section	Scheme	CBCS 18
Date	11-01-2021	CIE No.	3
Time	8.00-9.00 Am	Max. Marks	30

	Course Outcome Statements
After the successful completion of the course, the students will be able to	
CO1	**Explain** the construction management, planning and its scheduling by project tools
CO2	**Explain** the concept of resource and material management, and labour productivity
CO3	**Calculate** the productivity of construction equipment
CO4	**Explain** the quality, safety and human values for the effective construction management
CO5	**Explain** the principles of engineering economics by problem solving and decision making concept
CO6	**Explain** entrepreneurship and its role in infrastructural development

Q. No.	Questions	Marks	RBT Level	CO
	Answer any one full Question from each part			
	PART-A			
1a)	Explain the concept of Time value of money with examples	8	L1	5
1b)	Explain problem solving and decision making concepts.	7	L2	5
	OR			
2a)	Define a) sunk cost b) salvage value c) trade in value d) third party concept	8	L2	5
2b)	Differentiate between Micro economics and Macro economics	7	L3	5
	PART-B			
3a)	Explain the role of entrepreneurship in economic development.	8	L2	6
3b)	Explain micro and small enterprises with examples.	7	L3	6
	OR			
4a)	Write a short note on a) KSSIDC b) KSFC	8	L2	6
4b)	List the contents that should be involved in project plan.	7	L2	6

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

09/01/2021
Arpitha D J
Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Scheme of Valuation

se/Subject Title	Construction Management and Entrepreneurship.	Course/Subject Code	18CV51
ster	5th Sem.	CIE No.	3
	11/01/2021. ✓	Max. Marks	30

PART – A

)	Time value of Money Explination with an Example	6M
	one Any Cash flow diagram for Example	2M
		8M
b)	Explination on problem solving process with an Example for Identified problem	3M
	Decision making Example along with the neat flow chart and Explination	4M
		7M
	or	
a)	Sunk Cost :	
	Salvage value :	
	trade in value :	
	third party concept :	
2b)	Explination of Micro & Macro with two Examples Economics.	2M
	Any (6) ~~five~~ differences with Example.	5M
		7M

Course Coordinator (Faculty in charge) 8/01/2021

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Scheme of Valuation

PART–B

4a) Short note on

KSSIDC : Explination — 4M
Industry link

KSFC : Explination — 4M
Entrepreneurship link with KSFC

8M

4-b) All the project plan contents with Explination with a flow chart — 7M

7×1 = 7M

or

3a) Role of Entrepreneurship in Economic development — 8M

Any 8 — 8×1

3b) Explination of micro enterprises with an Example (Any two) — 3M

Small Enterprises Explination with any two Examples — 4M

7M

Course Coordinator (Faculty in charge) 6/11/2024

Coordinator DQAC

Program Coordinator (HOD, Civil)

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Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Assignment

Date	01	02	2021

Assignment No.	01	Maximum Marks	10
Course/Subject Title	Construction Management and Entrepreneurship	Course/Subject Code	18CV51
Semester	5th sem A Section	Scheme	CBCS – 18

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	Explain the construction management, planning and its scheduling by project tools
CO2	Explain the concept of resource and material management, and labour productivity
CO3	Calculate the productivity of construction equipment
CO4	Explain the quality, safety and human values for the effective construction management
CO5	Explain the principles of engineering economics by problem solving and decision making concept
CO6	Explain entrepreneurship and its role in infrastructural development

Note : Answer all questions

Q. No.	Question	Marks	RBT Level	CO
1	Explain minimum wages act and workmen compensation act.	5	L2	2
2	Briefly explain the concept of class of labour.	5	L3	2

Last date for submission	8	02	2021

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Arpitha D J 29/01/2021

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association (Regd.)

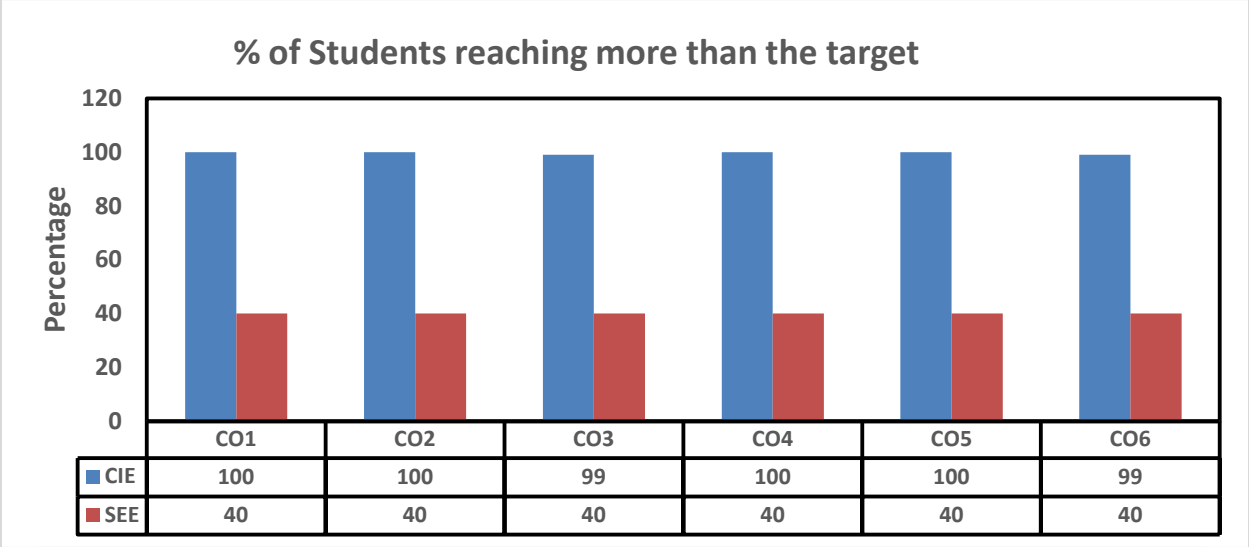
Bapuji Institute of Engineering and Technology, Davangere

Department: Civil Engineering

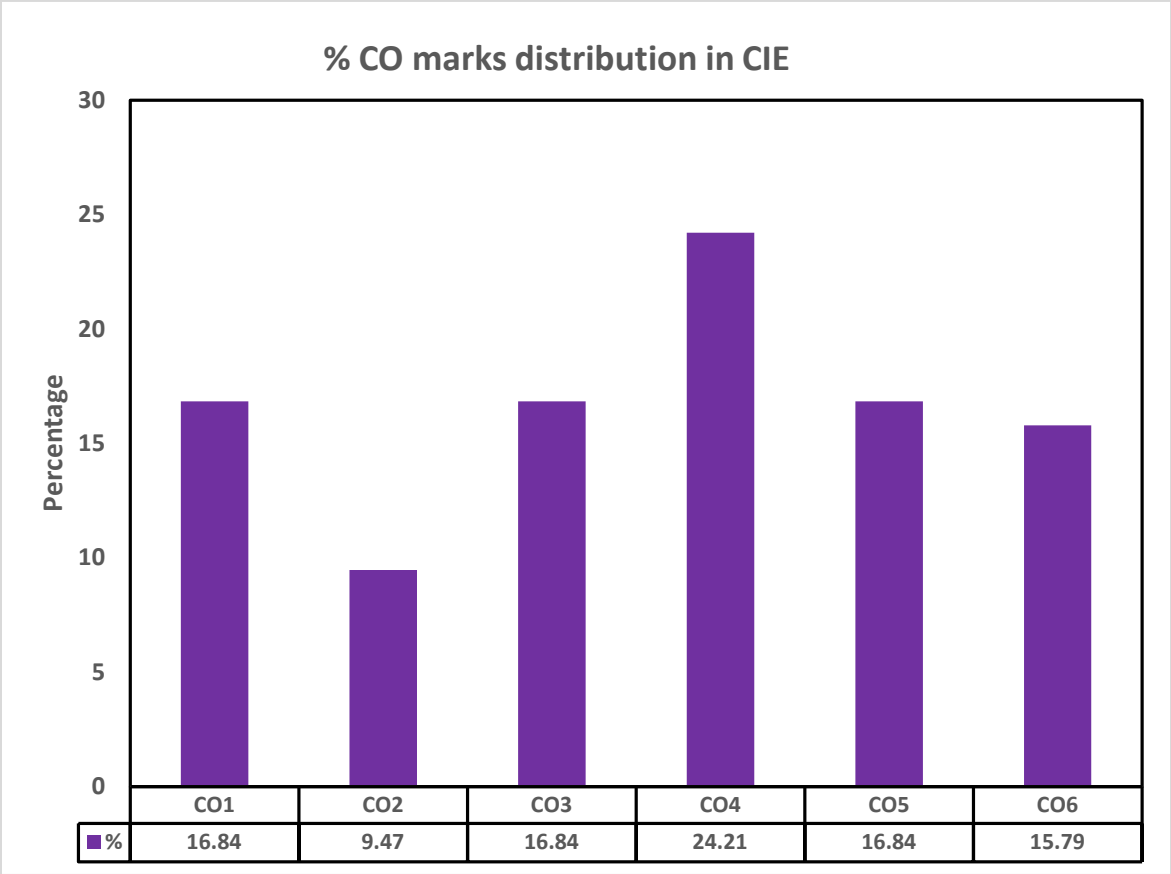
2020-2021(ODD SEM) Construction management and entruprunarship –(18CV51)

Branch/Course code/sec	No. of Students appeared for Exam.	No. of Students passed	PASS(% age)
civil engineering /18CV51/ A Sec	70	67	95.7%

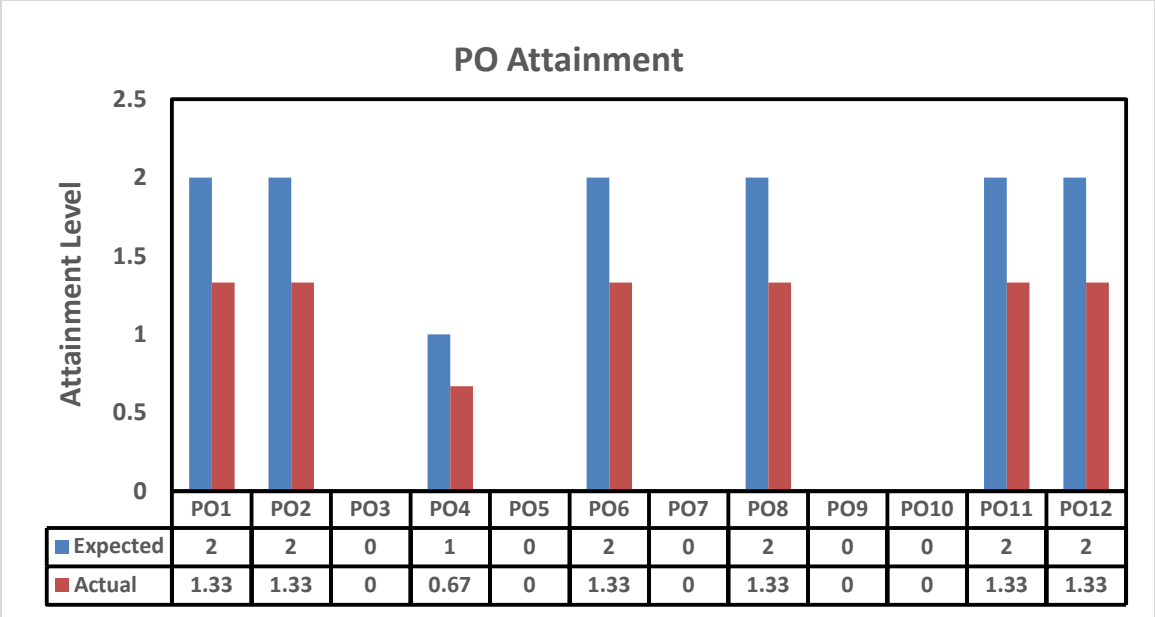
Construction Management and Entrepreneurship (18CV51)



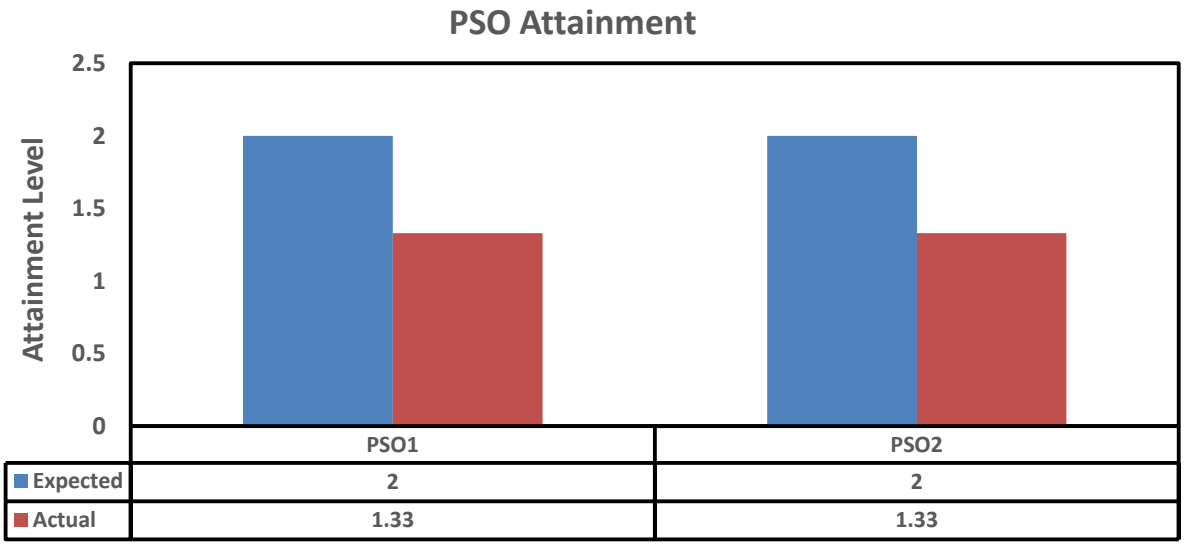
	CO1	CO2	CO3	CO4	CO5	CO6
CIE	100	100	99	100	100	99
SEE	40	40	40	40	40	40



	CO1	CO2	CO3	CO4	CO5	CO6
%	16.84	9.47	16.84	24.21	16.84	15.79



	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Expected	2	2	0	1	0	2	0	2	0	0	2	2
Actual	1.33	1.33	0	0.67	0	1.33	0	1.33	0	0	1.33	1.33



	PSO1	PSO2
Expected	2	2
Actual	1.33	1.33