


CMR Institute of Technology, Bangalore			
Department(s): Computer Science & Engineering			
Semester: 06	Section(s): A,B	Lectures/week: 04	
Subject: Cryptography, Network Security and Cyber Law		Code: 15CS61	
Course Instructor(s): APURVA KULKARNI			
Course duration: 01 Jan 2018 – 25 May 2018			
Course Site: https://sites.google.com/a/cmrit.ac.in/swetha/			

Course Objectives

- Explain the concepts of Cyber security
- Illustrate key management issues and solutions.
- Familiarize with Cryptography and very essential algorithms.
- Introduce cyber Law and ethics to be followed.

Prerequisites

- Integer Arithmetic
- Computer Networks

Lesson Plan

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-12	TB1: - 1,3,4,5.1, 5.2	MODULE 1 -Introduction - Cyber Attacks, Defence Strategies and Techniques, Guiding Principles, Mathematical Background for Cryptography - Modulo Arithmetic's, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem, Basics of Cryptography - Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties, Secret Key Cryptography – Product Ciphers, DES Construction.	Chalk and Talk Video Lectures for some topics	
Links to some useful online lectures: <ul style="list-style-type: none"> ➤ https://www.khanacademy.org/computing/computer-science/cryptography/crypt/v/caesar-cipher ➤ https://www.youtube.com/watch?v=E352JJ8xv48 ➤ https://www.youtube.com/watch?v=hQR_IHxXUOw 				
13-20	TB1 6,7,8	MODULE 2 -Public Key Cryptography and RSA – RSA Operations, Why Does RSA Work?, Performance, Applications, Practical Issues, Public Key Cryptography Standard (PKCS), Cryptographic Hash - Introduction, Properties, Construction, Applications and Performance, The Birthday Attack, Discrete Logarithm and its Applications - Introduction, Diffie-Hellman Key	Chalk and Talk Video Lectures for some topics	

		Exchange, Other Applications.		
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=Uk1mjEpW33s ➤ https://www.youtube.com/watch?v=bjWOG50PfdI&list=PLP6PHJ8SLR6AA93UEXGaDFUDc8paCCsiD&index=3 				
20-33	TB1 10,11,12, 13, 4	MODULE 3 -Key Management - Introduction, Digital Certificates, Public Key Infrastructure, Identity-based Encryption, Authentication-I - One way Authentication, Mutual Authentication, Dictionary Attacks, Authentication – II – Centralised Authentication, The Needham-Schroeder Protocol, Kerberos, Biometrics, IPSec- Security at the Network Layer – Security at Different layers: Pros and Cons, IPSec in Action, Internet Key Exchange (IKE) Protocol, Security Policy and IPSEC, Virtual Private Networks, Security at the Transport Layer - Introduction, SSL Handshake Protocol, SSL Record Layer Protocol, OpenSSL.	Chalk and Talk	
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=0Y6a8KJWQGE ➤ https://www.youtube.com/watch?v=hEwbTWYkh4A ➤ https://www.youtube.com/watch?v=WNlraSBwlh8 				
33-42	TB1 15, 19.1-19.5, 21.1-21.2, 22.1-22.4, 25	MODULE 4 -IEEE 802.11 Wireless LAN Security - Background, Authentication, Confidentiality and Integrity, Viruses, Worms, and Other Malware, Firewalls – Basics, Practical Issues, Intrusion Prevention and Detection - Introduction, Prevention Versus Detection, Types of Intrusion Detection Systems, DDoS Attacks Prevention/Detection, Web Service Security – Motivation, Technologies for Web Services, WS-Security, SAML, Other Standards.	Projector Video Lectures for some topics	
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=KZc1KaE1OKU, https://www.youtube.com/watch?v=GXBqFBKwM2o ➤ https://www.youtube.com/watch?v=vOgFZa9cmoQ 				
42-50	TB1 27	MODULE 5 -IT act aim and objectives, Scope of the act, Major Concepts, Important provisions, Attribution, acknowledgement, and dispatch of electronic records, Secure electronic records and secure digital signatures, Regulation of certifying authorities: Appointment of Controller and Other officers, Digital Signature certificates, Duties of Subscribers, Penalties and adjudication, The cyber regulations appellate tribunal, Offences, Network service providers not to be liable in certain cases, Miscellaneous Provisions.	Projector, Seminars	

Text Books

- | | |
|----|---|
| 1. | Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition |
|----|---|

Reference Books

- | | |
|----|---|
| 1. | Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay, Mc-GrawHill, 3rd Edition, 2015 |
| 2. | Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition |
| 3. | Cyber Law simplified- Vivek Sood, Mc-GrawHill, 11th reprint , 2013 |
| 4. | Cyber security and Cyber Laws, Alfred Basta, Nadine Basta, Mary brown, ravindra kumar, Cengage learning |

Syllabus for Internal Assessment Tests (IAT^{*})

IAT #	Syllabus
IAT-1	Class # 01 – 18
IAT-2	Class # 19–33
IAT-3	Class # 34–49

*See calendar of events for IAT schedule.

Course Outcomes

By the end of this course, students will be able to

1. Study different types of cyber attacks & motives behind cyber criminals.
2. Analyze various cryptography techniques and the underlying mathematics.
3. Illustrate various public key cryptography techniques.
4. Analyze various authentication and network security mechanisms.
5. Compare various methods used in launching attacks and the solutions to overcome the intrusions.
6. Demonstrate a critical understanding of the Cyber law with respect to Indian IT/Act 2000

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Explain different types of cyber attacks	1	2	1				2	1	1	1	1		2		1		

	& motives behind cyber criminals.																		
CO2	Analyze various cryptography techniques and the underlying mathematics.	1	2	2	2				2			1			2		1		
CO3	Illustrate various public key cryptography techniques.	2	2	2	1							1			2		1		
CO4	Analyze various authentication and network security mechanisms.	3	2	2	1	2	1	2				1			2		1	2	1
CO5	Compare various methods used in launching attacks and the solutions to overcome the intrusions.	4	2	2	2	2	1	2	1			1			2		1	2	1
CO6	Demonstrate a critical understanding of the Cyber law with respect to Indian IT/Act 2000	5	2	2		2		2	1	2	2	1	1	2	1	1	2	1	

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.


Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.
PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bangalore			 <p>CELEBRATING 25 YEARS</p> <p>CMR INSTITUTE OF TECHNOLOGY, BENGALURU.</p> <p>ACCREDITED WITH A+ GRADE BY NAAC</p>
Department(s): Computer Science & Engineering			
Semester: 06	Section(s): A&B	Lectures/week: 04	
Subject: Computer Graphics and Visualization		Code: 15CS62	
Course Instructor(s): Shivaraj V B			
Course duration: 01 Jan 2018 – 25 May 2018			
Course Site:			

Course Objectives

- Explain hardware, software and OpenGL Graphics Primitives.
- Illustrate interactive computer graphic using the OpenGL.
- Design and implementation of algorithms for 2D graphics Primitives and attributes.
- Demonstrate Geometric transformations, viewing on both 2D and 3D objects.
- Infer the representation of curves, surfaces, Color and Illumination models

Prerequisites

- Programming proficiency in C or C++
- Rudimentary knowledge of linear algebra, trigonometry, calculus
- Basic data structures.

Lesson Plan				
Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-10	Text1: Chapter - 1: 1-1 to 1-9, 2-1 to 2-9 (Excluding 2-5), 3-1 to 3-5, 3-9, 3-20	Module 1: Computer Graphics and OpenGL: Computer Graphics: Basics of computer graphics, Application of Computer Graphics, Video Display Devices: Random Scan and Raster Scan displays, color CRT monitors, Flat panel displays. Raster-scan systems: video controller, raster scan Display processor, graphics Workstations and viewing systems, Input devices, graphics networks, graphics on the internet, graphics software. OpenGL: Introduction to OpenGL ,coordinate reference frames, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms(DDA, Bresenham's), circle generation algorithms (Bresenham's).	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures: <ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=M4Q4bljzWNs ➤ https://www.youtube.com/watch?v=5NV7HDI4xWk ➤ https://www.youtube.com/watch?v=1Te8U_JR8SI 				
11-20	Text-1: Chapter 3-14 to 3-16, 4-9, 4-10, 4-14, 5-1 to 5-7, 5-17, 6-1, 6-4	Module 2 : Fill area Primitives, 2D Geometric Transformations and 2D viewing: Fill area Primitives: Polygon fill-areas, OpenGL polygon fill area functions, fill area attributes, general scan line polygon fill algorithm, OpenGL fill-area attribute functions. 2D Geometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates. Inverse transformations, 2D Composite transformations, other 2D transformations, raster methods for geometric transformations, OpenGL raster transformations, and OpenGL geometric transformations function, 2D viewing: 2D viewing pipeline, OpenGL 2D viewing functions.	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures: <ul style="list-style-type: none"> ➤ http://freevideolectures.com/Course/2275/Computer-Graphics/18 ➤ http://slideplayer.com/slide/9699628/ ➤ http://slideplayer.com/slide/7665305/ ➤ http://slideplayer.com/slide/249019/ 				
21-30	Text1: Chapter :6-2 to 6-08	Module 3 : Clipping, 3D Geometric Transformations, Color and Illumination Models: Clipping: clipping window, normalization and viewport transformations, clipping algorithms, 2D point clipping, 2D line clipping algorithms: cohen-sutherland line clipping only	Chalk and Talk	20

	<p>(Excluding 6-4), 5-9 to 5-17</p> <p>(Excluding 5-15),12-1,12-2,12-4,12-6,10-1,10-3</p>	<p>-polygon fill area clipping: Sutherland-Hodgeman polygon clipping algorithm only.3DGeometric Transformations: 3D translation, rotation, scaling, composite 3D transformations, other 3D transformations, affine transformations, OpenGL geometric transformations functions. Color Models: Properties of light, color models, RGB and CMY color models. Illumination Models: Light sources, basic illumination models-Ambient light, diffuse reflection, Specular and phong model, Corresponding openGL functions.</p>		
<p>Links to some useful online lectures:</p> <ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=RGSnIK4-BhI ➤ https://www.youtube.com/watch?v=ePiFbqun5MI ➤ https://www.youtube.com/watch?v=2Snoepcmi9U ➤ https://www.youtube.com/watch?v=gFZqzVQrw84 				
31-41	<p>Text1:</p> <p>Chapter: 7-1 to 7-10</p> <p>(Excluding 7-7), 9-1 to 9-3, 9-14</p>	<p>Module 4 : 3D Viewing and Visible Surface Detection: 3DViewing:3D viewing concepts, 3D viewing pipeline, 3D viewing coordinate parameters , Transformation from world to viewing coordinates, Projection transformation, orthogonal projections, perspective projections, The viewport transformation and 3D screen coordinates. OpenGL 3D viewing functions. Visible Surface Detection Methods: Classification of visible surface Detection algorithms, back face detection, depth buffer method and OpenGL visibility detection functions.</p>	<p>Chalk and Talk</p> <p>Video Lectures for some topics</p>	20
<p>Links to some useful online lectures:</p> <ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=TsjYPu7piY0 ➤ https://www.youtube.com/watch?v=8eAI01PdCZA 				
<p>Links to some useful online lectures:</p> <ul style="list-style-type: none"> ➤ 				
41-50	<p>Text1:</p> <p>Chapter :8-3 to 8-6</p> <p>(Excluding 8-5),8-9,8-10,8-11,3-8,8-18,13-11,3-2,13-3,13-4,13-10</p> <p>Text 2:</p> <p>Chapter 3: 3-1 to 3.11:</p> <p>Input& interaction</p>	<p>Module 5 : Input& interaction, Curves and Computer Animation: Input and Interaction: Input devices, clients and servers, Display Lists, Display Lists and Modeling, Programming Event Driven Input, Menus Picking, Building Interactive Models, Animating Interactive programs, Design of Interactive programs, Logic operations .Curved surfaces, quadric surfaces, OpenGL Quadric-Surface and Cubic-Surface Functions, Bezier Spline Curves, Bezier surfaces, OpenGL curve functions. Corresponding openGL functions.</p>	<p>Chalk and Talk</p> <p>Video Lectures for some topics</p>	20
<p>Links to some useful online lectures:</p> <ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=MsAMp6cijL0 				

Text Books

1.	Donald Hearn & Pauline Baker: Computer Graphics with OpenGL Version, 3rd / 4th Edition, Pearson Education, 2011
2.	Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008

Reference Books

5.	James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education
6.	Xiang, Plastock: Computer Graphics, sham's outline series, 2nd edition, TMG.
7.	Kelvin Sung, Peter Shirley, Steven Baer : Interactive Computer Graphics, concepts and applications, Cengage Learning
8.	M M Raiker, Computer Graphics using OpenGL, Filip learning/Elsevier

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Syllabus
IAT-1	Class # 01-20
IAT-2	Class # 21-35
IAT-3	Class # 36-50

*See calendar of events for IAT schedule.

Course Outcomes

By the end of this course, students will be able to

1. Design and implement algorithms for 2D graphics primitives and attributes.
2. Illustrate Geometric transformations on both 2D and 3D objects.
3. Apply concepts of clipping and visible surface detection in 2D and 3D viewing, and Illumination Models.
4. Decide suitable hardware and software for developing graphics packages using OpenGL.

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Design and implement algorithms for 2D graphics primitives and attributes.	1	1	2	2	2	-	-	-	-	-	-	-	1	1	-	-	-
CO2	Illustrate Geometric transformations on both 2D and 3D objects.	2,3	2	2	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO3	Apply concepts of clipping and visible surface detection in 2D and 3D viewing, and Illumination Models.	2,3,4	2	2	2	2	2	-	-	-	-	-	-	1	-	-	-	1
CO4	Decide suitable hardware and software for developing graphics packages using OpenGL.	1,4,5	1	2	2	2	2	1	-	-	-	-	1	1	2	-	-	1

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when,

	where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.


Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.
PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium

3	Substantial/ High
---	-------------------

CMR Institute of Technology, Bangalore			
Department(s): Computer Science & Engineering			
Semester: 06	Section(s): A,B&C	Lectures/week: 05	
Subject: System Software & Compiler Design		Code: 15CS63	
Course Instructor(s): Sagarika Behera			
Course duration: 05Feb 2018 – 25 May 2018			
Course Site: https://sites.google.com/a/cmrit.ac.in/sagarika/courses			

Course Objectives

- Define System Software such as Assemblers, Loaders, Linkers and Macroprocessors.
- Familiarize with source file, object file and executable file structures and libraries.
- Describe the front-end and back-end phases of compiler and their importance to students

Prerequisites

- Automata Theory - NFA, DFA, Epsilon NFA
- State transition diagram
 - Regular expression.
 - Context Free grammar
 - Assembly language programming
- Computer organization

Lesson Plan

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-10	TB2: - 1.1 to 1.6 & 3.1-3.9	MODULE-3 : Lexical Analysis: Introduction, Alphabets and Tokens in Computer Languages, Representation, Token Recognition and Finite Automata, Implementation, Error Recovery.	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ http://www.nptelvideos.in/2012/11/compiler-design.html ➤ https://www.youtube.com/watch?v=Qkwj65I_96I&list=PLEbnTDJUr_IcPtUXFy2b1sGRPsLFMghhS 				
11-24	TB2 4.1-4.9	MODULE 4 - Syntax Analysis: Introduction, Role Of Parsers, Context Free Grammars, Top Down Parsers, Bottom-Up Parsers, Operator-Precedence	Chalk and Talk Video	20

		Parsing	Lectures for some topics	
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=N9UuAPU6DAg ➤ https://www.youtube.com/watch?v=n5UWAaw_byw 				
25-35	TB2 5.1 - 5.5	MODULE 5 -Syntax Directed Translation, Intermediate code generation, Code generation	Chalk and Talk	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=queUceGJqh0 ➤ https://www.youtube.com/watch?v=EpAzj7zXrbk ➤ https://www.youtube.com/watch?v=IRvaRhPsqOo 				
36-47	TB1 1.1-1.3 2.1-2.4 4.1-4.2	MODULE 1 - Introduction to System Software, Machine Architecture of SIC and SIC/XE. Assemblers: Basic assembler functions, machine dependent assembler features, machine independent assembler features, assembler design options. Macroprocessors: Basic macro processor functions,	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=VG9VopzV_T0 ➤ https://www.youtube.com/watch?v=BmhQvFwKK94 				
48-58	TB1 3.1-3.5	MODULE 2 -Loaders and Linkers: Basic Loader Functions, Machine Dependent Loader Features, Machine Independent Loader Features, Loader Design Options, Implementation Examples.	Chalk and Talk	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=xDmwFIBVTjY 				

Text Books

1.	System Software by Leland. L. Beck, D Manjula, 3 rd edition, 2012, ISBN:978-8131764602
2.	Compilers-Principles, Techniques and Tools by Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman. Pearson, 2 nd edition, 2007, ISBN:978-8131797310
Reference Books	
9.	Systems programming – Srimanta Pal , Oxford university press, 2016
10.	System programming and Compiler Design, K C Loudon, Cengage Learning
11.	System software and operating system by D. M. Dhamdhere TMG
12.	Compiler Design, K Muneeswaran, Oxford University Press 2013.

Syllabus for Internal Assessment Tests (IAT^{*})

IAT #	Syllabus
IAT-1	Class # 01 – 24
IAT-2	Class # 25-44

*See calendar of events for IAT schedule.

Course Outcomes	
By the end of this course, students will be able to	
1. Explain system software such as assemblers, loaders, linkers and macroprocessors	
2. Develop lexical analyzers, parsers and code generators	
3. Apply the knowledge of lex tool & yacc tool to develop a scanner & parser.	
4. Design software system for backend of the compiler for implementation.	
5. Develop program for solution of complex problems in compiler	

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Explain system software such as assemblers, loaders, linkers and macroprocessors	1,2	2	2	2	2	-	2	-	-	1	1	-	1	1	-	1	-
CO2	Develop lexical analyzers, parsers and code generators	3,4,5	2	3	3	3	2	2	1	-	2	1	1	2	1	-	1	-
CO3	Apply the knowledge of lex tool & yacc tool to develop a scanner & parser.	3,4	2	3	3	3	2	2	1	-	2	1	1	1	1	-	1	-
CO4	Design software system for backend of the compiler for implementation.	5	2	2	3	2	2	2	1	-	1	1	1	1	1	-	1	-
CO5	Develop program for solution of complex problems in compiler	5	2	2	2	2	2	2	1	-	1	1	1	1	1	-	1	-

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.


Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.
PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bangalore		
Department(s): Computer Science & Engineering		
Semester: 06	Section(s): C	
Operating System	15CS64	Lectures/week: 04
Course Instructor(s): Sherly Noel		
Course duration: 01 Feb., 2018 – 25 May 2018		

Course Objectives	
<ul style="list-style-type: none"> ➤ Introduce concepts and terminology used in OS ➤ Explain threading and multithreaded systems ➤ Illustrate process synchronization and concept of Deadlock ➤ Introduce Memory and Virtual memory management, File system and storage techniques 	
Prerequisites	
<ul style="list-style-type: none"> ➤ Knowledge of Computer system (hardware & Software) ➤ Types of operating system and its usage ➤ Computer Organization concepts ➤ Elementary data structures and algorithms ➤ Programming skills (Knowledge of C) 	

LESSON PLAN

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-13	TB1: 1.1 – 1.12 2.1 – 2.10 3.1 – 3.4	Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments. Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot. Process Management Process concept; Process scheduling; Operations on processes; Inter process communication	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ Video Lecture :https://www.youtube.com/watch?v=HEjPop-aK_w ➤ Video Lecture :https://www.youtube.com/watch?v=bS3QuOQgUu8 				
14-23	TB1: 4.1 – 4.4 5.1 – 5.5 6.1 – 6.7	Multi-threaded Programming: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling; Thread scheduling. Process Synchronization: Synchronization: The critical section problem; Peterson’s solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ Video Lecture :https://www.youtube.com/watch?v=Gjfiuj3lm2o ➤ Video Lecture :https://www.youtube.com/watch?v=JNYiru0_Hwk 				
24-33	TB1 7.1 – 7.7 8.1 – 8.6	Deadlocks : Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock	Chalk and Talk	20

		detection and recovery from deadlock. Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.		
--	--	--	--	--

Links to some useful online lectures:

- Video Lecture :<https://www.youtube.com/watch?v=8M0o2FH3RUo>
- Video Lecture :<https://www.youtube.com/watch?v=TZ7YtlrfAIs>

34-43	TB1 9.1 – 9.6 10.1 – 10.6	Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. File System, Implementation of File System: File system: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.	Chalk and Talk Video Lectures for some topics	20
-------	---------------------------------	---	--	----

Links to some useful online lectures:

- Video Lecture :<https://www.youtube.com/watch?v=Ub4VVDGLJx0>
- Video Lecture :<https://www.youtube.com/watch?v=ZJ1LLAB0mJ0>

44-52	TB1 7.1- 7.4 8.1 -8.3	Secondary Storage Structures, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems. Case Study: The Linux Operating System: Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication.	Chalk and Talk Video Lectures for some topics	20
-------	-----------------------------	---	--	----

Links to some useful online lectures:

- Video Lecture :<https://www.youtube.com/watch?v=PQ5aK5wLCQE>
- Video Lecture : <https://www.youtube.com/watch?v=V2Gxqv3bJCK>

Text Books

1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7 th edition, Wiley-India, 2006.
----	--

Reference Books

6.	Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6 th Edition
7.	D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw-Hill, 2013.
8.	P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.

9.	William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.
----	---

Course Outcomes

By the end of this course, students will be able to

1. Analyze the structure of OS and basic architectural components involved in OS design
2. Explain the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS
3. Use processor, memory, storage and file system commands
4. Explain synchronization among concurrently-executing processes and issues/solutions to mutual exclusion
5. Identify potential threats to operating systems and defend the need for protection and security

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Analyze the structure of OS and basic architectural components involved in OS design	1,2,3,4,5	1	0	3	0	1	0	0	0	0	0	1	1	1	1	3	0
CO2	Explain the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS	1,2,3,4,5	1	0	2	1	1	0	0	0	0	0	1	1	1	1	3	0
CO3	Use processor, virtual memory, storage and file system commands	2,3,4,5	1	0	2	1	1	0	0	0	0	0	1	1	1	1	3	0
CO4	Explain synchronization among concurrently-executing processes and issues/solutions to mutual exclusion	1,2,3,4	1	2	2	1	1	0	0	0	0	0	1	1	1	1	3	0
CO5	Identify potential threats to operating systems and defend the need for protection and security	1,2,3,4,5	1	1	2	1	1	0	0	0	0	0	1	1	1	1	3	0

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)


PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.
PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

Note : From time to time, assignments will be posted on

<https://sites.google.com/a/cmrit.ac.in/operating-system-6-sem-c/>

CMR Institute of Technology, Bangalore			
Department(s): Information Science & Engineering			
Semester: 06	Section(s): CS-A,B,C&ISE-A,B	Lectures/week: 04	
Subject: Mobile Application development		Code: 15CS661	
Course Instructor(s): Anu Jose			
Course duration: 05 Jan 2018 – 23May 2018			
Course Site: https://sites.google.com/a/cmrit.ac.in/anu-jose1/			

Course Objectives

- Learn to setup Android application development environment
- Illustrate user interfaces for interacting with apps and triggering actions
- Interpret tasks used in handling multiple activities
- Identify options to save persistent application data
- Appraise the role of security and performance in Android applications.

Pre requisites

- Java Programming Language
- Object-oriented programming
- XML - properties / attributes

Lesson Plan

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-10	TB1: - 1.0-1.4 2.1- 2.3 3.1-3.3	UNIT1 -Introduction to Android, Create Your First Android App, Layouts Views and Resources, Text and Scrolling Views, Understanding Activities and Intents, The Activity Lifecycle and Managing State, Activities and Implicit Intents, The Android Studio Debugger, Testing your App, The Android Support Library	Chalk and Talk PowerPoint Video Lectures for some topics	20

Links to some useful online lectures:

- https://www.youtube.com/watch?v=zHIUfQ5eN0U&list=PLlyCyjh2pUe9wv-hU4my-Nen_SvXIzxGB&index=16
- https://www.youtube.com/watch?v=1vFO_7fE2w&list=PLlyCyjh2pUe9wv-hU4my-Nen_SvXIzxGB&index=11

10-20	TB1 4.1 - 4.4 5.1- 5.3 6.1	UNIT2 -User Input Controls, Menus, Screen Navigation, RecyclerView, Drawables, Styles and Themes, Material Design, Providing Resources for Adaptive Layouts, Testing the User Interface	Chalk and Talk PowerPoint Video Lectures for some topics	20
-------	-------------------------------------	--	--	----

Links to some useful online lectures:

- <https://www.youtube.com/watch?v=MjthkVD2cbc&list=PLlyCyjh2pUe9wv-hU4my->

<p>Nen SvXIzxGB&index=36</p> <p>➤ https://www.youtube.com/watch?v=XaLvo7veY7Q&list=PLlyCyjh2pUe9wv-hU4my-Nen SvXIzxGB&index=35</p>				
20-30	TB1 7.1 - 7.4 8.1-8.3	UNIT3 -AsyncTask and AsyncTaskLoader, Broadcast Receivers, Services, Notifications, Scheduling Alarms, Transferring Data Efficiently, Connect to the Internet	Chalk and Talk	20
<p>Links to some useful online lectures:</p> <p>➤ https://www.youtube.com/watch?v=Uf4V5OSJji8&list=PLlyCyjh2pUe9wv-hU4my-Nen SvXIzxGB&index=44</p> <p>➤ https://www.youtube.com/watch?v=Tyj1irY3SMk&index=51&list=PLlyCyjh2pUe9wv-hU4my-Nen SvXIzxGB</p>				
30-39	TB1 9.0: -9.2 10.0-10.1 11.1 12.1	UNIT 4 -Storing Data, Shared Preferences, App Settings, SQLite Primer, SQLite Database, Share Data Through Content Providers Loaders	Chalk and Talk PowerPoint Video Lectures for some topics	20
<p>Links to some useful online lectures:</p> <p>➤ https://www.youtube.com/watch?v=GhzAnjrPOYU&list=PLlyCyjh2pUe9wv-hU4my-Nen SvXIzxGB&index=52</p>				
40-46	TB1 13.1 14.1 15.1	UNIT 5 -Permissions, Performance and Security, Firebase and AdMob, Publish!	Video Lectures	20
<p>Links to some useful online lectures:</p> <p>➤ https://www.youtube.com/watch?v=etNi1w9Oo5c&index=66&list=PLlyCyjh2pUe9wv-hU4my-Nen SvXIzxGB</p> <p>➤ https://www.youtube.com/watch?v=jtIsg7QW-Lo&index=67&list=PLlyCyjh2pUe9wv-hU4my-Nen SvXIzxGB</p> <p>➤ https://www.youtube.com/watch?v=P8-q01rLbxA&index=65&list=PLlyCyjh2pUe9wv-hU4my-Nen SvXIzxGB</p>				

Text Books

1.	Google Developer Training, "Android Developer Fundamentals Course – Concept Reference”, Google Developer Training Team, 2017.
----	---

Reference Books

1.	Erik Hellman, “Android Programming – Pushing the Limits”, 1 st Edition, Wiley India Pvt Ltd, 2014.
2.	2. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1 st Edition, O’Reilly SPD Publishers, 2015.

3.	J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
4.	Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2

Syllabus for Internal Assessment Tests (IAT^{*})

IAT #	Syllabus
IAT-1	Class # 01 – 18
IAT-2	Class # 19– 37
IAT-3	Class # 38– 52

*See calendar of events for IAT schedule.

Course Outcomes

By the end of this course, students will be able to

Create, test and debug Android application by setting up Android development environment

Implement adaptive, responsive user interfaces that work across a wide range of devices.

Infer long running tasks and background work in Android applications

Demonstrate methods in storing, sharing and retrieving data in Android applications

Analyze performance of android applications and understand the role of permissions and security

Describe the steps involved in publishing Android application to share with the world

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Create, test and debug Android application by setting up Android development environment	1	1	1	2	-	2	-	-	-	1	1	-	-	2	-	-	-
CO2	Implement adaptive, responsive user interfaces that work across a wide range of devices.	1,2	1	1	2	2	2	-	-	-	1	1	-	1	2	-	-	-
CO3	Infer long running tasks and background work in Android applications	1,3	1	2	-	1	1	-	-	-	1	1	-	-	1	-	-	-
CO4	Demonstrate methods in storing, sharing and retrieving data in Android applications	4	1	1	1	1	-	-	-	-	1	2	-	1	1	-	-	-
CO5	Analyze performance of android applications and understand the role of permissions and security	5	1	1	1	1	1	1	-	2	1	-	-	1	1	-	-	-

CO6	Describe the steps involved in publishing Android application to share with the world	5	1	-	1	1	1	-	-	-	1	2	-	1	1	-	-
-----	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.


Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.

PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bangalore			
Department(s): Computer Science & Engineering			
Semester: 06	Section(s): A,B&C	Lectures/week: 04	
Subject: Data Mining and Data warehousing		Code: 15CS651	
Course Instructor(s): Shilpa Pande/Aiswarya Lakshmi K			
Course duration: 01 Jan 2018 – 25 May 2018			
Course Site: https://sites.google.com/a/cmrit.ac.in/shilpapande5487/			

Course Objectives

- Define multi-dimensional data models
- Explain rules related to association, classification and clustering analysis
- Compare and contrast between different classification and clustering algorithms

Prerequisites

- Basic DBMA concepts
- Basic mathematical concepts

Lesson Plan

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-8	TB2: - 4.1,4.2	Module 1:Data Warehousing & modeling: Basic Concepts: Data Warehousing: A multitier Architecture, Data warehouse models: Enterprise warehouse, Data mart and virtual warehouse, Extraction, Transformation and loading, Data Cube: A multidimensional data model, Stars, Snowflakes and Fact constellations: Schemas for	Chalk and Talk Video Lectures for some topics	20

		multidimensional Data models, Dimensions: The role of concept Hierarchies, Measures: Their Categorization and computation, Typical OLAP Operations.		
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=HV8lwTjzslw&t=231s ➤ https://www.youtube.com/watch?v=O7JYornSvjI&t=142s 				
9-18	TB2 4.3,4.4 TB1: 2.1-2.4	Module 2: Data warehouse implementation& Data mining: Efficient Data Cube computation: An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP. : Introduction: What is data mining, Challenges, Data Mining Tasks, Data: Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity,	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=LzmAbi5ZOHE ➤ https://www.youtube.com/watch?v=FBtQNhK_U58 				
19-28	TB1 6.1-6.7	Module 3: Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FP-Growth Algorithm, Evaluation of Association Patterns	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=WGIMIS_Yydk ➤ https://www.youtube.com/watch?v=gq6nKbye648 				
29-38	TB1 4.1-4.3,4.6 5.1-5.3	Module 4: Classification : Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=ivBSZZyaRHY 				
39-52	TB1 8.1 -8.5 9.3-9.5	Module 5: Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithms.	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures:				
<ul style="list-style-type: none"> ➤ https://www.youtube.com/watch?v=JXaJZAtTq6M ➤ https://www.youtube.com/watch?v=b9gPL6NvsnA&list=PLBv09BD7ez_6lYVoZ1RzVcOPIT5Lfjo0Y 				

Text Books

1.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson Education, 2005. 978-81-317-5904-2
2.	Jiawei Han, Micheline Kamber, Jian Pei: Data mining-Concepts and Techniques, 3rd edition, Morgan Kaufmann Publisher, 2012 978-0-12-381479-1
Reference Books	
10.	Sam Anahory, Dennis Murray : Data warehousing in the real world, Pearson, Tenth Impression , 2012
11.	Michael J. Berry, Gordon S. Linoff : Mastering Data Mining, Wiley Edition, Second edition , 2012

Syllabus for Internal Assessment Tests (IAT*)

IAT #	Syllabus
IAT-1	Class # 01 – 18
IAT-2	Class # 19–37
IAT-3	Class # 38–52

*See calendar of events for IAT schedule.

Course Outcomes

By the end of this course, students will be able to

5. Identify data mining problems and implement the data warehouse.
6. Write association rules for a given data pattern.
7. Choose between classification and clustering solution.

**Based on table 01, 02, 03 in appendix, following are the Course outcomes.

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Apply the basic concepts of data warehousing and data mining	Unit 1,2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	To describe and develop various data mining techniques for solving real world problems	2,3	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	Analyse various patterns to estimate the accuracy of algorithm	4,5	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	Apply preprocessing steps of data for data mining	2,3	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1

Note: Assignments, study material, Question bank and other course related content would be posted on site mentioned above.

Appendix

Table 01: Cognitive Levels

Cognitive Levels	
Cognitive level	Revised Blooms Taxonomy Keywords
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend


L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

Table 02: Program Outcomes (PO) and Program Specific Outcomes (PSO)

Program Outcomes (PO), Program Specific Outcomes (PSO)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.
PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

Table 03: Correlation Levels

Correlation Levels	
0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

CMR Institute of Technology, Bangalore			
Department(s): Computer Science & Engineering			
Semester: 06	Section(s): A,B&C		
Big Data Analytics		15CS662	Lectures/week: 04
Course Instructor(s): Dr Hanumantha Ravi P V N			
Course duration: 05 Feb., 2018 – 25 May 2018			

Course Objectives
<ul style="list-style-type: none"> ➤ Interpret the data in the context of the business. ➤ Identify an appropriate method to analyse the data ➤ Show analytical model of a system
Prerequisites
<ul style="list-style-type: none"> ➤ Elementary Statistics ➤ Microsoft Excel (Desirable)

LESSON PLAN

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-10	TB 1.1-2.6; 3.1-3.5	MODULE 1:- Introduction to Data Analytics and Decision Making: Introduction, The Methods, The Software, Modeling and Models, Graphical Models, Algebraic Models, Spreadsheet Models, Seven-Step Modeling Process Describing the Distribution of a Single Variable: Introduction, Basic Concepts, Populations and Samples, Data Sets, Variables, and Observations, Types of Data, Descriptive Measures for Categorical Variables, Descriptive Measures for Numerical Variables, Numerical Summary Measures, Numerical Summary Measures with StatTools, Charts for Numerical Variables, Time Series Data, Outliers and Missing Values, Outliers, Missing Values, Excel Tables for Filtering, Sorting and Summarizing. Finding Relationships among Variables: Introduction, Relationships among Categorical Variables, Relationships among Categorical Variables and a Numerical Variable, Stacked and Unstacked Formats, Relationships among Numerical Variables, Scatterplots, Correlation and Covariance, Pivot Tables.	Chalk and Talk Video Lectures for some topics	20
11-25	TB 4.1 – 5.6	MODULE 2:- Probability and Probability Distributions: Introduction, Probability Essentials, Rule of Complements, Addition Rule, Conditional Probability and the Multiplication Rule, Probabilistic Independence, Equally Likely Events, Subjective Versus Objective Probabilities, Probability Distribution of a Single Random Variable,	Chalk and Talk Video Lectures for some topics	20

		<p>Summary Measures of a Probability Distribution, Conditional Mean and Variance, Introduction to Simulation. Normal, Binomial, Poisson and Exponential Distributions: Introduction, The Normal Distribution, Continuous Distributions and Density Functions, The Normal Density, Standardizing Z-Values, Normal Tables and Z-Values, Normal Calculations in Excel, Empirical Rules Revisited, Weighted Sums of Normal Random Variables, Applications of the Normal Random Distribution, The Binomial Distribution, Mean and Standard Deviation of the Binomial Distribution, The Binomial Distribution in the Context of Sampling, The Normal Approximation to the Binomial, Applications of the Binomial Distribution, The Poisson and Exponential Distributions, The Poisson Distribution, The Exponential Distribution.</p>		
26-37	TB 6.1 - 6.5; 7.1-7.4	<p>MODULE 3:-Decision Making under Uncertainty: Introduction, Elements of Decision Analysis, Payoff Tables, Possible Decision Criteria, Expected Monetary Value (EMV), Sensitivity Analysis, Decision Trees, Risk Profiles, The Precision Tree Add-In, Bayes' Rule, Multistage Decision Problems and the Value of Information, The Value of Information, Risk Aversion and Expected Utility, Utility Functions, Exponential Utility, Certainty Equivalents, Is Expected Utility Maximization Used?</p> <p>Sampling and Sampling Distributions: Introduction, Sampling Terminology, Methods for Selecting Random Samples, Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling, Multistage Sampling Schemes, Introduction to Estimation, Sources of Estimation Error, Key Terms in Sampling, Sampling Distribution of the Sample Mean, The Central Limit Theorem, Sample Size Selection, Summary of Key Ideas for Simple Random Sampling.</p>	Chalk and Talk	20
38-50	TB 8.1-8.9; 9.1-9.6	<p>MODULE 4:-Confidence Interval Estimation: Introduction, Sampling Distributions, The t Distribution, Other Sampling Distributions, Confidence Interval for a Mean, Confidence Interval for a Total, Confidence Interval for a Proportion, Confidence Interval for a Standard Deviation, Confidence Interval for the Difference between Means, Independent Samples, Paired Samples, Confidence Interval for the Difference between Proportions, Sample Size Selection, Sample Size Selection for Estimation of the Mean, Sample Size Selection for Estimation of Other Parameters.</p> <p>Hypothesis Testing: Introduction, Concepts in Hypothesis Testing, Null and Alternative Hypothesis, One-Tailed Versus Two-Tailed Tests, Types of Errors, Significance Level and Rejection Region, Significance from p-values, Type II Errors and Power, Hypothesis Tests and Confidence Intervals, Practical versus Statistical Significance, Hypothesis Tests for a Population Mean, Hypothesis Tests for Other Parameters, Hypothesis Tests for a Population Proportion, Hypothesis Tests for Differences between Population Means, Hypothesis Test for Equal Population Variances, Hypothesis Tests for Difference between Population Proportions, Tests for Normality, Chi-Square Test for Independence.</p>	Chalk and Talk	20

51-60	TB 10.1 - 10.7; 11.1-11.9	<p>MODULE 5:-Regression Analysis: Estimating Relationships: Introduction, Scatterplots:Graphing Relationships, Linear versus Nonlinear Relationships,Outliers,UnequalVariance, No Relationship,Correlations:Indications of Linear Relationships,Simple Linear Regression, Least Squares Estimation, Standard Error of Estimate,The Percentage of Variation Explained:R-Square,Multiple Regression,Interpretation of Regression Coefficients, Interpretation of Standard Error ofEstimate and R-Square, Modeling Possibilities, Dummy Variables, InteractionVariables, Nonlinear Transformations, Validation of the Fit.</p> <p>Regression Analysis: Statistical Inference:Introduction,The Statistical Model,Inferences About the Regression Coefficients, Sampling Distribution of theRegression Coefficients, Hypothesis Tests for the Regression Coefficients and p-Values, A Test for the Overall Fit: The ANOVATable,Multicollinearity,Include/Exclude Decisions, Stepwise Regression,Outliers, Violations of Regression Assumptions,Nonconstant Error Variance,Nonnormality of Residuals,Autocorrelated Residuals,Prediction.</p>	Chalk and Talk	20
-------	---------------------------------	---	----------------	----

Links to some useful online lectures:

- <https://www.youtube.com/watch?v=THODdNXOjRw>
- <https://www.youtube.com/watch?v=R0GjjPvswlQ&t=20s>
- https://www.youtube.com/playlist?list=PLm5jvBcJgJBUmtV_GSwbrsH4MwbACAKDH
- <https://www.youtube.com/watch?v=GiWqKE-yznE>

Text Books

- | | |
|----|---|
| 1. | S C Albright and W L Winston, Business analytics: data analysis and decision making, 5/e Cenage Learning (TB) |
|----|---|

Reference Books

Syllabus for Internal Assessment Tests (IAT) *

IAT #	Syllabus
IAT-1	1-25 Lectures
IAT-2	26-50 Lectures
IAT-3	51-60 Lectures

* See calendar of events for the schedules of IATs.

Course Outcomes

By the end of this course, students will be able to

1. Explain the importance of data and data analysis.
2. Interpret the probabilistic models for data
12. Define hypothesis, uncertainty principle

13. Evaluate regression analysis

COGNITIVE LEVELS	
Cognitive level	REVISED BLOOMS TAXONOMY KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PROGRAM OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO)	
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.


PO11	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.
PO12	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.
PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

CORRELATION LEVELS

0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Explain the importance of data and data analysis.	1,4,5	2	2	3	2	1	3	2	2	2	-	-	-	3	-	1	-
CO2	Interpret the probabilistic models for data	1,2,3	2	1	3	1	1	2	2	2	2	-	-	-	2	-	1	-
CO3	Define hypothesis, uncertainty principle	4,5	2	2	2	2	2	2	2	2	2	-	-	-	3	-	1	-
CO4	Evaluate regression analysis	5	2	1	2	2	2	2	2	2	2	-	-	-	2	-	1	-

Note:- From time to time, assignments will be posted on <https://sites.google.com/a/cmrit.ac.in/hanumantha-ravi/>

CMR Institute of Technology, Bangalore		
Department(s): Computer Science & Engineering		
Semester: 06	Section(s): C	
OPERATION RESEARCH	15CS653	Lectures/week: 04
Course Instructor(s): Dr Hanumantha Ravi P V N		
Course duration: 05 Feb. 2018 – 25 May 2018		

Course Objectives

- Formulate optimization problem as a linear programming problem.
- Solve optimization problems using simplex method.
- Formulate and solve transportation and assignment problems.
- Apply game theory for decision making problems..

Prerequisites

- Solving system of linear equations

LESSON PLAN

Lecture #	Book & Sections	Topics	Portions coverage	
			Teaching Aids	% of Syllabus Covered
1-10	TB: - 1.1-1.21; 2.1-2.8	MODULE 1: Introduction, Linear Programming: Introduction: The origin, nature and impact of OR; Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation . Introduction to Linear Programming Problem (LPP): Prototype example, Assumptions of LPP, Formulation of LPP and Graphical method various examples.	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures: https://www.youtube.com/watch?v=FdKgeeb4q3w https://www.youtube.com/watch?v=xY6AlnGZ1bw https://www.youtube.com/watch?v=xY6AlnGZ1bw https://www.youtube.com/watch?v=NYZ206ccuzY https://www.youtube.com/watch?v=cvRWORxDAY8				
11-20	TB 2.9 – 2.18	MODULE 2: Simplex Method–1: The essence of the simplex method; Setting up the simplex method; Types of variables, Algebra of the simplex method; the simplex method in tabular form; Tie breaking in the simplex method, Big M method, Two phase method.	Chalk and Talk Video Lectures for some topics	20
Links to some useful online lectures: https://www.youtube.com/watch?v=reswxJMC0iM https://www.youtube.com/watch?v=i4ig7Cpravo https://www.youtube.com/watch?v=kh2qKN1jEAA https://www.youtube.com/watch?v=CiLG14fsPdc https://www.youtube.com/watch?v=kvlp2CfDUQ https://www.youtube.com/watch?v=uhTN6KvCC8				
21-32	TB 6.1 - 6.6	MODULE 3: Simplex Method–2: Duality Theory - The essence of duality theory, Primal dual relationship, conversion of primal to dual problem and vice versa. The dual simplex method.	Chalk and Talk	20

Links to some useful online lectures:

<https://www.youtube.com/watch?v=0TRxEvMRE7s>
<https://www.youtube.com/watch?v=ly26wUsE1Kc>
<https://www.youtube.com/watch?v=qS5DCpfivQYh>
https://www.youtube.com/watch?v=o1pznRt_-y0
<https://www.youtube.com/watch?v=FfXFWYf8wss>
<https://www.youtube.com/watch?v=qkRKEFXMrPs>
https://www.youtube.com/watch?v=lmIaGnC_Xro
<https://www.youtube.com/watch?v=Ndt2gp6CO6s>

33-44	TB 3.1- 3.8 4.1 -4.6	MODULE 4:- Transportation and Assignment Problems:The transportation problem, InitialBasic Feasible Solution (IBFS) by North West Corner Rule method, MatrixMinima Method, Vogel'sApproximation Method. Optimal solution by Modified Distribution Method (MODI). The Assignment problem; A Hungarian algorithmfor the assignment problem. Minimization and Maximization varieties intransportation and assignment problems.	Chalk and Talk Video Lectures for some topics	20
-------	----------------------------	--	--	----

Links to some useful online lectures:

<https://www.youtube.com/watch?v=ItOuvM2KmD4>
<https://www.youtube.com/watch?v=-w2z3MVTcQA>
<https://www.youtube.com/watch?v=rrFFTdO2Z7I>
<https://www.youtube.com/watch?v=-0DEQmp7B9o>
<https://www.youtube.com/watch?v=aPVtIhnwHPE>
<https://www.youtube.com/watch?v=qAuzFrnvGMY>
<https://www.youtube.com/watch?v=slUnWRtfvg>
<https://www.youtube.com/watch?v=gPINOJ4YPt4>

45-56	RB1 17.1 - 17.6; 18.1: RB3 7.1-7.13; 8.1-8.6	MODULE 5:- Game Theory: Game Theory: The formulation of two persons, zero sum games;saddle point, maxi min and min max principle, Solving simple games- a prototypeexample; Games with mixed strategies; Graphical solutionprocedure.Metaheuristics: The nature of Metaheuristics, Tabu Search, SimulatedAnnealing, Genetic Algorithms.	Chalk and Talk Video Lectures for some topics	20
-------	---	--	--	----

Links to some useful online lectures:

<https://www.youtube.com/watch?v=fSuqTgnCVRg>
<https://www.youtube.com/watch?v=YJvbxAvxkDc>
<https://www.youtube.com/watch?v=KUSkAasVCYh>
<https://www.youtube.com/watch?v=VWQIplwLmhGk>

Text Books

- | | |
|----|--|
| 1. | D.S. Hira and P.K. Gupta, Operations Research, (Revised Edition), Published by S. Chand & Company Ltd, 2014 (TB) |
|----|--|

Reference Books

- | | |
|-----|---|
| 14. | S Kalavathy, Operation Research, Vikas Publishing House Pvt Limited, 01-Aug-2002 (RB 1) |
| 15. | S D Sharma, Operation Research, KedarNath Ram Nath Publishers. (RB 2) |
| 16. | Sreenivasa Reddy M, Operations Research, Interline Publishing. (RB 3) |

Syllabus for Internal Assessment Tests (IAT) *

IAT #	Syllabus
IAT-1	Class # 01 – 20
IAT-2	Class # 21–45

* : See calendar of events for the schedules of IATs.

Course Outcomes

By the end of this course, students will be able to

2. Select and apply optimization techniques for various problems.
2. Model the given problem as transportation and assignment problem and solve.
17. Apply game theory for decision support system.

COGNITIVE LEVELS

Cognitive level	REVISED BLOOMS TAXONOMY KEYWORDS
L1	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
L2	summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
L3	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover.
L4	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer.
L5	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize.

PROGRAM OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO)

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	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.
PO12	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.
PSO1	Design, implement and maintain business applications in a variety of languages using libraries and frameworks.
PSO2	Develop and simulate wired and wireless network protocols for various network applications using modern tools.
PSO3	Apply the knowledge of software and design of hardware to develop embedded systems for real world applications.
PSO4	Apply knowledge of web programming and design to develop web based applications using database and other technologies

CORRELATION LEVELS

0	No Correlation
1	Slight/Low
2	Moderate/ Medium
3	Substantial/ High

Course Outcomes		Modules covered	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Select and apply optimization techniques for various problems.	1,2,3,4	2	2	2	1	1	1	1	-	-	-	-	-	2	-	1	-
CO2	Model the given problem as transportation and assignment problem and solve.	4	2	2	2	1	1	1	1	-	-	-	-	-	2	-	1	-
CO3	Apply game theory for decision support system.	5	2	2	2	1	1	1	1	-	-	-	-	-	2	-	1	-

Note: From time to time, assignments will be posted on

<https://sites.google.com/a/cmrit.ac.in/hanumantha-ravi/>