


COURSE INFORMATION	
	<b>DEPARTMENT OF POLYTECHNIC AND COMMUNITY COLLEGE EDUCATION, MINISTRY OF EDUCATION MALAYSIA</b>

1	<b>NAME OF COURSE</b> : POWER SYSTEM
	<b>COURSE CODE</b> : DET30053
2	<b>SYNOPSIS:</b>  <b>POWER SYSTEM</b> course will provide students with the concepts of non-renewable and renewable energy. It also annotate on the environmentally friendly electrical power generation, transmission, distribution and consumerization of the electrical power.
3	<b>NAME(S) OF ACADEMIC STAFF</b> :
4	<b>SEMESTER AND YEAR OFFERED</b> :
5	<b>CREDIT VALUE</b> : 3
6	<b>PREREQUISITE/CO-REQUISITE (IF ANY)</b> : DET20033
7	<b>COURSE LEARNING OUTCOMES (CLO):</b>  Upon completion of this course, students should be able to: <div>             Apply the concepts of eco-friendly electrical power generation resources, to improve an environmentally conscious of a quality power generation, transmission and distribution system and its efficiency  <b>CLO1 :</b> ( C3 , PLO 1 )           </div> <div>             Perform the practical works on electrical power generation, transmission and distribution system using an appropriate energy-efficient equipment.  <b>CLO2 :</b> ( P4 , PLO 5 )           </div> <div>             Demonstrate the awareness toward the sustainable energy generation and environmental friendly methodes of transmission and distribution system.  <b>CLO3 :</b> ( A3 , PLO 7 )           </div>

8	MAPPING OF THE COURSE LEARNING OUTCOMES TO THE PROGRAMME LEARNING OUTCOMES, TEACHING METHODS AND ASSESSMENT:															
		Programme Learning Outcomes (PLO)														

9	<b>TRANSFERABLE SKILLS:</b> <div>a. Knowledge</div> <div>b. Modern Tool Usage</div> <div>c. Environment and Sustainability</div>																																																																																																																															
10	<b>DISTRIBUTION OF STUDENT LEARNING TIME (SLT):</b> <table><tr><th rowspan="3">Course Content Outline</th><th rowspan="3">CLO*</th><th colspan="6">Teaching and Learning Activities</th><th rowspan="3">SLT</th></tr><tr><th colspan="4">Guided Learning (F2F)</th><th rowspan="2">Guided Learning (NF2F) eg: e-Learning</th><th rowspan="2">Independent Learning (NF2F)</th></tr><tr><th>L</th><th>P</th><th>T</th><th>O</th></tr><tr><td>1. INTRODUCTION TO POWER SYSTEM 1.1 Remember the definition of power system 1.2 Understand the concept of renewable energy 1.3 Understand the concept of non renewable energy 1.4 Understand the usage of renewable energy</td><td>CLO1</td><td>2.65</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2.65</td><td>5.3</td></tr><tr><td></td><td>CLO2</td><td>0</td><td>6</td><td>0</td><td>0</td><td>0</td><td>3</td><td>9</td></tr><tr><td></td><td>CLO3</td><td>0</td><td>0</td><td>0</td><td>1.5</td><td>0</td><td>1.5</td><td>3</td></tr><tr><td>2.0 GENERATION 2.1 Understand the electrical power generation 2.2 Apply the efficient power generation</td><td>CLO1</td><td>5</td><td>0</td><td>0</td><td>0</td><td>0</td><td>5</td><td>10</td></tr><tr><td></td><td>CLO2</td><td>0</td><td>4</td><td>0</td><td>0</td><td>0</td><td>2</td><td>6</td></tr><tr><td>3.0 TRANSMISSION LINES 3.1 Understand the nature of transmission lines 3.2 Apply the understanding of transmission lines 3.3 Understand the voltage regulation concepts 3.4 Apply the understanding of voltage regulation concepts 3.5 Elaborate the losses in transmission lines 3.6 Understand the function of transmission's insulator 3.7 Apply the function of transmission's insulators</td><td>CLO1</td><td>6.85</td><td>0</td><td>0</td><td>0</td><td>0</td><td>6.85</td><td>13.7</td></tr><tr><td></td><td>CLO2</td><td>0</td><td>6</td><td>0</td><td>0</td><td>0</td><td>3</td><td>9</td></tr><tr><td></td><td>CLO3</td><td>0</td><td>0</td><td>0</td><td>1.5</td><td>0</td><td>1.5</td><td>3</td></tr><tr><td>4.0 DISTRIBUTION SYSTEMS 4.1 Remember the distribution system 4.2 Understand the flow of distribution system 4.3 Apply the energy efficiency in distribution system 4.4 Know the role of distribution substations Inductors and inductance 4.5 Apply the busbar arrangement 4.6 Understand the characteristics of distribution cables 4.7 Apply the knowledge of distribution cables 4.8 Apply the role of distribution substations</td><td>CLO1</td><td>5</td><td>0</td><td>0</td><td>0</td><td>0</td><td>5</td><td>10</td></tr><tr><td></td><td>CLO2</td><td>0</td><td>4</td><td>0</td><td>0</td><td>0</td><td>2</td><td>6</td></tr><tr><td>5.0 CONSUMERIZATION 5.1 Remember the power quality issues 5.2 Understand of electrical energy demand 5.3 Apply the understanding of electrical energy demand</td><td>CLO1</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td><td>6</td></tr><tr><td colspan="9">TOTAL: 81</td></tr></table>	Course Content Outline	CLO*	Teaching and Learning Activities						SLT	Guided Learning (F2F)				Guided Learning (NF2F) eg: e-Learning	Independent Learning (NF2F)	L	P	T	O	1. INTRODUCTION TO POWER SYSTEM 1.1 Remember the definition of power system 1.2 Understand the concept of renewable energy 1.3 Understand the concept of non renewable energy 1.4 Understand the usage of renewable energy	CLO1	2.65	0	0	0	0	2.65	5.3		CLO2	0	6	0	0	0	3	9		CLO3	0	0	0	1.5	0	1.5	3	2.0 GENERATION 2.1 Understand the electrical power generation 2.2 Apply the efficient power generation	CLO1	5	0	0	0	0	5	10		CLO2	0	4	0	0	0	2	6	3.0 TRANSMISSION LINES 3.1 Understand the nature of transmission lines 3.2 Apply the understanding of transmission lines 3.3 Understand the voltage regulation concepts 3.4 Apply the understanding of voltage regulation concepts 3.5 Elaborate the losses in transmission lines 3.6 Understand the function of transmission's insulator 3.7 Apply the function of transmission's insulators	CLO1	6.85	0	0	0	0	6.85	13.7		CLO2	0	6	0	0	0	3	9		CLO3	0	0	0	1.5	0	1.5	3	4.0 DISTRIBUTION SYSTEMS 4.1 Remember the distribution system 4.2 Understand the flow of distribution system 4.3 Apply the energy efficiency in distribution system 4.4 Know the role of distribution substations Inductors and inductance 4.5 Apply the busbar arrangement 4.6 Understand the characteristics of distribution cables 4.7 Apply the knowledge of distribution cables 4.8 Apply the role of distribution substations	CLO1	5	0	0	0	0	5	10		CLO2	0	4	0	0	0	2	6	5.0 CONSUMERIZATION 5.1 Remember the power quality issues 5.2 Understand of electrical energy demand 5.3 Apply the understanding of electrical energy demand	CLO1	3	0	0	0	0	3	6	TOTAL: 81								
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CONTINUOUS ASSESSMENT	PERCENTAGE (%)	F2F	NF2F	SLT
Quiz	5	0.5	0.5	1
Test	10	1	1	2
Practical Work	25	6	3	9
Practical Test	5	2	2	4
Essay (Generic Skills)	5	1	1	2
Essay	10	0	13	13
<b>TOTAL</b>				<b>31</b>

FINAL ASSESSMENT	PERCENTAGE (%)	F2F	NF2F	SLT
Final Examination	40	2	6	8
<b>TOTAL</b>				<b>8</b>

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**\*\*Please tick (✓) if this course is Latihan Industri/ Clinical Placement/ Practicum/ WBL using 2-weeks, 1 credit formula**

L = Lecture, T = Tutorial, P= Practical, O= Others, F2F=Face to Face, NF2F=Non Face to Face

\*Indicate the CLO based on the CLO's numbering in Item 8.

**GRAND**  
**TOTAL SLT: 120**

11	<p><b>SPECIAL REQUIREMENT OR RESOURCES TO DELIVER THE COURSE:</b></p> <p>Trainer Laboratory</p>
12	<p><b>REFERENCES:</b></p> <p><b>Main reference supporting the course</b></p> <p>B. M. Weedy, B. J. Cory, N. Jenkins, Janaka B. Ekanayake, Goran Strbac. (2013). <i>Electric Power Systems</i>. Hoboken, United States: John Wiley and Sons Ltd.</p> <p><b>Additional references supporting the course</b></p> <p>Ashby, D. (2012). <i>Electrical Engineering 101</i>. Oxford, United Kingdom: Elsevier Science &amp; Technology.</p> <p>Kirtley, J. L. (2010). <i>Electric Power Principles : Sources, Conversion, Distribution and Use</i>. Hoboken, United States: John Wiley and Sons Ltd.</p> <p>Mehta, V. K. (2011). <i>Principles of Electrical Engineering</i>. New Delhi, India: S Chand &amp; Co Ltd.</p> <p>Stiebler, M. (2010). <i>Wind Energy Systems for Electric Power Generation</i>. Springer-Verlag Berlin and Heidelberg GmbH &amp; Co. KG: Springer-Verlag Berlin and Heidelberg GmbH &amp; Co. KG.</p> <p>Wadhwa, C. L. (2018). <i>Electrical Power Systems</i>. Tunbridge Wells, United Kingdom: New Academic Science Ltd.</p>

13	<p><b>OTHER ADDITIONAL INFORMATION:</b></p> <p><b><u>GENERIC SKILLS</u></b></p> <p>a. Environment &amp; Sustainability</p> <p>Attribute: Social Responsibilities</p> <p>Sub Attribute :</p> <ul style="list-style-type: none"><li>i. Contribution to communities</li><li>ii . Sustainability &amp; Environment Friendly</li></ul> <p>Reference: iCGPA Rubric Learning Outcomes Assessment Guide 2016.</p> <p>The generic skill(s) need to be assessed at least <b>TWO (2)</b> times.</p>
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14	<p><b>COURSE SYLLABUS:</b></p> <p><b>1.0 Introduction to Power System</b></p> <p>1.1 Remember the concept of power system</p> <p>1.1.1 Define the power system definition</p> <p>1.1.2 List the components in power system</p> <p>1.1.3 Describe the significant of eco-friendly power generation, transmission and distribution of power system.</p> <p>1.2 Understand the concept of renewable energy</p> <p>1.2.1 Explain the concept of renewable energy</p> <p>1.2.2 Discuss source of renewable energy</p> <p>a. Solar energy</p> <p>b. Wind energy</p> <p>c. Hydro energy</p> <p>d. Biomass energy</p> <p>e. Biofuel energy</p> <p>f. Geothermal energy</p> <p>1.3 Understand the concept of non-renewable energy</p> <p>1.3.1 Explain the concept of non-renewable energy</p> <p>1.3.2 Discuss source of non-renewable energy</p> <p>a. fuel</p> <p>b. coal</p> <p>c. nuclear</p> <p>d. gas</p> <p>1.4 Understand the usage of renewable energy</p> <p>1.4.1 Explain the advantages and disadvantages of renewable energy and non-renewable energy</p> <p>1.4.2 Explain the importance of renewable energy</p> <p>1.4.3 Explain the methods used in generating electrical power from the renewable energy source mentioned in section 1.2.2.</p> <p><b>2.0 Generation</b></p> <p>2.1 Understand the electrical power generation</p> <p>2.1.1 Explain the function of electrical power generation</p> <p>2.1.2 Discuss types of power generation plant</p> <p>a. Hydro power generation</p> <p>b. Thermal power generation</p> <p>c. Wind turbine power generation</p> <p>d. Solar power generation</p> <p>2.2 Apply an efficient power generation</p> <p>2.2.1 Draw the operational block diagram of the following power plant</p> <p>a. Hydro power plant</p> <p>b. Thermal power plant</p>
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- 2.2.2 Write the advantages and disadvantages of power generation plants mentioned in section 2.1.2 according to:
  - a. Installation cost
  - b. Maintenance cost
  - c. Availability
  - d. Location
  - e. Environmental impact
  - f. Output power
- 2.2.3 Draw the operational block diagram for eco-friendly methods used to treat power plant waste:
  - a. Near surface disposal (nuclear)
  - b. deep geological disposal (nuclear)
  - c. flow gas desulfurization (fuel, gas and coal)
  - d. electrostatics precipitator , (coal, biomass)
  - e. heat recovery steam generator (gas)

### 3.0 Transmission Lines

- 3.1 Understand the nature of transmission lines
  - 3.1.1 Describe the function of transmission line
  - 3.1.2 Explain the types of transmission line
    - a. Short transmission line
    - b. Medium transmission line
    - c. Long transmission line
- 3.2 Apply the understanding of transmission lines
  - 3.2.1 Draw an equivalent circuit diagram for short transmission lines, medium transmission line and long transmission line
  - 3.2.2 Draw a single phase phasor diagram for short transmission line carrying load with lagging power factor (current as a reference).
- 3.3 Understand the voltage regulation concept
  - 3.3.1 Explain voltage regulation
  - 3.3.2 Explain transmission efficiency
  - 3.3.3 Explain the effects of high and low voltage on transmission efficiency
- 3.4 Apply the understanding of voltage regulation concept
  - 3.4.1 Calculate current based on apparent power and real power
  - 3.4.2 Calculate the power factor based on sending end or receiving end voltage
  - 3.4.3 Calculate the voltage regulation
  - 3.4.4 Calculate transmission efficiency
- 3.5 Understand the losses in transmission lines
  - 3.5.1 Discuss corona and its effects
  - 3.5.2 Discuss conductor loss and its effects
  - 3.5.3 Discuss dielectric heating loss and its effects



- 3.6 Understand the function of transmission's insulators
  - 3.6.1 Discuss the function of insulators in transmission line
  - 3.6.2 Outline the steps to install insulators network
  - 3.6.3 Visualize the diagram of the following insulators :
    - a. Pin insulator
    - b. Suspension insulator
    - c. Tension/string insulator
  - 3.6.4 Compare the advantages and disadvantages of pin-type, suspension-type and tension-type insulators.
- 3.7 Apply the function of transmission's insulators
  - 3.7.1 Show the distributed voltage theory in insulator network
  - 3.7.2 Calculate the voltage across insulator network
  - 3.7.3 Show the accessories needed to improve insulator network efficiency
    - a. Cross arm
    - b. Guard ring

#### **4.0 Distribution Systems**

- 4.1 Remember the distribution system
  - 4.1.1 Describe the distribution system function
  - 4.1.2 Recognize the IEC (International Electro technical Commission) standard symbols used in power system
    - a. Generator
    - b. Motor
    - c. Bus bar
    - d. Current transformer
    - e. Voltage transformer
    - f. Circuit breaker
    - g. Fuse
- 4.2 Understand the flow of distribution system
  - 4.2.1 Visualize a power distribution to consumers by using a single line diagram
  - 4.2.2 Explain with a suitable diagram distribution arrangement of the following feeders:
    - a. Radial
    - b. Parallel
    - c. Ring
    - d. Simple network
- 4.3 Apply the energy efficiency in distribution system
  - 4.3.1 Show the advantages and disadvantages of radial and ring feeders in terms of cost efficiency and supply suitability
  - 4.3.2 Show the differences between the distribution system for domestic and industrial use

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|  | <ul style="list-style-type: none"><li>4.4 Remember the role of distribution substations<ul style="list-style-type: none"><li>4.4.1 Identify the role of distribution substations</li><li>4.4.2 List the advantages and disadvantages of substation inside and outside of buildings in terms of cost, noise and disturbance</li><li>4.4.3 Describe the bus bar function.</li><li>4.4.4 Describe type of bus bar arrangements:<ul style="list-style-type: none"><li>a. Single</li><li>b. Dual</li><li>c. Ring</li></ul></li><li>4.4.5 List the advantages and disadvantages of each bus bar arrangement mentioned in section 4.4.4</li></ul></li><li>4.5 Apply the bus bar arrangement<ul style="list-style-type: none"><li>4.5.1 Sketch a single line diagram for each bus bar arrangement in section 4.4.4</li><li>4.5.2 Show the operations of each bus bar arrangements in section 4.4.4</li></ul></li><li>4.6 Understand the characteristics of distribution cables<ul style="list-style-type: none"><li>4.6.1 Explain the primary requirements for the underground distribution cables</li><li>4.6.2 Explain the structure of underground distribution cables</li></ul></li><li>4.7 Apply the knowledge of distribution cables<ul style="list-style-type: none"><li>4.7.1 Sketch the structure of underground distribution cables</li><li>4.7.2 Show the advantages and disadvantages of underground cable system compared to overhead distribution cable system</li></ul></li><li>4.8 Apply the role of distribution substation<ul style="list-style-type: none"><li>4.8.1 Show the role of distribution substation</li><li>4.8.2 Show the functions and symbols of the following substation components:<ul style="list-style-type: none"><li>a. Transformer with tapping</li><li>b. Circuit breaker</li><li>c. Air-breaker switch</li><li>d. Isolator</li><li>e. Surge arrester</li><li>f. Earthing switch</li><li>g. Current-limiting reactor</li><li>h. Instrument transformer</li></ul></li></ul></li></ul> |
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	<p><b>5.0 Consumerization</b></p> <p>5.1 Remember the power quality issues</p> <p>5.1.1 List the significant of power quality to consumer</p> <p>5.1.2 Describe the factors that contribute to power quality</p> <ol style="list-style-type: none"> <li>Under voltage and over voltage</li> <li>Sags and surge voltage</li> <li>Blackout</li> <li>Harmonics distortion</li> </ol> <p>5.1.3 Describe the methods used to enhance the power quality</p> <ol style="list-style-type: none"> <li>Surge Protector</li> <li>Uninterrupted Power Supply</li> <li>Backup Generator</li> <li>Passive filter</li> </ol> <p>5.2 Understand the electrical energy demand</p> <p>5.2.1 Explain the demand curve for load consumption in 24 hours</p> <p>5.2.2 Explain maximum load demand, sum of generated power per day average load, load factor and diversity factor</p> <p>5.3 Apply the understanding of electrical energy demand</p> <p>5.3.1 Sketch the demand curve for load consumption in 24 hours</p> <p>5.3.2 Calculate maximum load demand, sum of generated power per day average load, load factor and diversity factor</p> <p><b>Suggested Sequence of Topics</b></p>
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ASSESSMENT:

The course assessment consist of:

i. Continuous Assessment (CA) – 60%

ii. Final Examination (FE) /Final Assessment (FA) – 40%

Final examination/ Final assessment is carried out at the end of the semester.

CLO	PLO	CLS	DT	PROPOSED TEACHING & LEARNING ACTIVITIES	CONTINUOUS ASSESSMENT WEIGHTAGE (%)						FINAL ASSESSMENT WEIGHTAGE (%)	SLT (hours)	PROPOSED TOPIC
					Quiz	Theory Test	Practical Work	Practical Test	Essay		Final Examination		
					(2) 5%	(1) 10%	(6) 25%	(1) 5%	5%	(1) 10%	(1) 40%		
CLO1 : Apply the concepts of eco-friendly electrical power generation resources, to improve an environmentally conscious of a quality power generation, transmission and distribution system and its efficiency	1	1	C3	Interactive lecture	•							69.0	T1-T2, T3-T4
						•							T1-T5
				Discussion						•			T1/T2/T3/T4/T5
				Final Examination							•		T1-T5
CLO2 : Perform the practical works on electrical power generation, transmission and distribution system using an appropriate energy-efficient equipment.	5	3a	P4	Practical Work			•					43.0	T2-T4
							•						T2/T3/T4
CLO3 : Demonstrate the awareness toward the sustainable energy generation and environmental friendly methodes of transmission and distribution system.	7	5	A3	Discussion					•			8.0	T1/T2/T3/T4/T5
											TOTAL SLT:	120	

Remarks/ Notes:

DT : DOMAIN TAXONOMY

/ : OR

- : UNTIL

, : AND